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ABSTRACT

A battery of reading tests designed to identify the component skills involved in reading comprehension was administered to 624 sixth grade students in the metropolitan Sydney (Australia) schools. Factor analysis of the data showed that knowledge of word meanings, sentence comprehension, and semantic context are experimentally identifiable components of reading comprehension. Less conclusive evidence indicates that reading speed and comprehension as determined by logically derived questions might also be components of reading comprehension. All tests in the battery measure knowledge of word meanings and semantic context, while some of the tests measure one or more additional components, such as sentence comprehension, reasoning, and perceptual speed (reading speed or processing speed). The patterns of factor loadings indicate that it is possible to assess comprehension without simultaneously assessing a person's inferential abilities. (The implications of these results for testing programs, test construction, reading instruction, and the search for a definition of reading comprehension are discussed. Appendixes provide details concerning test sources, test construction, test administration, reliability coefficients, and factor analyses. A list of references is included.) (RL)

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MEASURING READING COMPREHENSION
IN THE
UPPER PRIMARY SCHOOL

D.Spearritt
with assistance from
D.Spalding and M.Johnston

The University of Sydney

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The study reported in these pages is concerned with the identification and measurement of the components of reading comprehension. The proposal for the study was developed by the author as part of a larger proposal for a study of language comprehension while he was working during a period of leave from the University of Sydney with Dr. John B. Carroll at Educational Testing Service in 1971-2, and with the support of the National Institute of Child Health and Human Development under Research Grant 1-PO1-HD01762 to Educational Testing Service. On the author's return to Australia, he submitted a proposal for a study of reading comprehension to the Australian Advisory Committee for Research and Development in Education (now the Education Research and Development Committee), which subsequently provided the funds for the project. Some additional funding in the form of personnel and computer processing costs was made available through the University of Sydney research grant.

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D.S.

CHAPTER I

INTRODUCTION

One of the most important functions of formal education is to develop in children the ability to understand what they read. Their degree of understanding has to be assessed in some way, and teachers have commonly employed such practices as asking children to reproduce in speech or writing the substance of what they have read, or to provide spoken or written responses to specific questions put to them about a particular passage. Since the 1920's, another commonly accepted method of assessing children's comprehension has been the multiple-choice form of reading comprehension test, in which children are required to demonstrate their understanding of passages presented to them by answering multiple-choice questions based on these passages. This form of reading comprehension test is in wide use at primary and secondary levels of schooling and also in testing programmes for admission to tertiary educational institutions.

The nature of the skills involved in reading comprehension has attracted the attention of reading specialists and educational researchers since early this century and especially since E.L. Thorndike's studies of mistakes in paragraph reading (1917). In recent years there has been an upsurge of interest in this question. Davis, a major investigator in the field of experimental studies of reading comprehension skills, followed up his earlier studies (Davis, 1944) with an intensive large-scale study of a number of aspects of reading comprehension which he hypothesized as representing separate skills (Davis, 1968). His conclusion that there were five experimentally distinguishable skills in reading comprehension was contested by R.L. Thorndike (1971). It was subsequently shown, however, (Spearritt, 1972) that four of the skills were distinguishable, but that nevertheless the reading comprehension skills were so highly intercorrelated that they could be measuring one basic ability such as "reasoning in reading", as maintained by R.L. Thorndike. In addition to the interest generated in reading comprehension skills by research of this kind which has been based on the multiple-choice form of reading comprehension test, the development of new approaches to the testing of reading comprehension such as the cloze test (Taylor, 1953) and the chunked test (Carver, 1970) sparked off speculation about the different types of skills likely to be tapped by the different types of reading comprehension test (Carroll, 1972).

This questioning of the skills being measured by reading comprehension tests is a natural outcome of the marked increase in knowledge over the last twenty years about the linguistic development of children. In order to comprehend written utterances or verbal discourse, children need to have attained some competence in each of the three major subsystems of language - the lexical or semantic subsystem, the grammatical or syntactical subsystem, and the phonological - orthographic subsystem. Comprehension is likely to be impaired by lack of competence in any of these subsystems. The recognition that the act of comprehending printed verbal material calls on a child's knowledge of the phonological and orthographic symbols of the language concerned, its grammatical and syntactical relationships, the meaning of words and phrases and the components of words such as prefixes and suffixes has given rise to the notion that reading comprehension skills should be measured in finer detail than they are at the present time.

This idea has been strongly pressed by Carroll (1969, 1972), who claims that reading comprehension tests measure inference-drawing abilities rather than "simple comprehension" or "pure" comprehension of language. He suggests that separate measures of "comprehension" and "inference" are required in reading tests, and calls for research to determine whether it is possible to develop tests of comprehension which do not call upon "processes of inference, deduction and problem-solving" (Carroll, 1972). Tests of reading comprehension should at least reflect two distinct phases of the reading process, viz. "the comprehension of the literal sense of what is read and the inferring of deeper meanings that are not explicitly stated" (Carroll, 1969). He claims that "when we use a reading comprehension test, we ought to know exactly what it is supposed to be measuring" (Carroll. 1969). This claim seems clearly justifiable, regardless of whether we are seeking a test which will provide a general index of reading comprehension or tests which will yield diagnostic information about different aspects of reading comprehension.

The present study was undertaken to identify by empirical means the linguistic skills and other mental skills involved in reading comprehension. A particular aim of the study was to determine whether it is practicable to assess comprehension without at the same time assessing a child's inferential abilities. Data obtained in the course of answering these questions would provide information about the pattern of skills measured by the various kinds of reading comprehension test. It was expected that the study would provide a basis for the development by test construction agencies of more precisely formulated instruments for measuring reading comprehension, and thus for improved diagnosis and treatment of comprehension deficiencies among school children as well as more complete profiles of children's skills in reading comprehension. To take account of the findings of sociolinguists such as Bernstein (1961, 1962), the study was designed so that comparative data would be available on the relative levels of linguistic competence of children of different socio-economic class levels.

CHAPTER II

THE NATURE OF READING COMPREHENSION

A person is said to comprehend a spoken or written communication when he grasps its meaning or understands the message or information being conveyed. Two types of comprehension are commonly distinguished, according to the form in which the communication is presented. If it consists of spoken material, the process of understanding such material is often described, in abbreviated form, as "listening comprehension". The analogous label of "reading comprehension" is applied to the comprehension of meaningful verbal material presented in written or printed form.

There is abundant evidence from everyday experience that children differ in the amount of meaning they can extract from a given passage, or in other words, they differ in reading comprehension. The extent of this difference can be readily gauged from the responses of two children to part of a passage used in this investigation, in which they were required to insert the words which had been deliberately omitted from the passage. The inserted words are underlined.

First Child

A long time ago the little fish of the sea were at school
down under the sea safe from dangerous animals. One
pupil, Jimmie Cod, was not studying. He was looking at
something dangling in front of him. He could not take
his eyes off this shiny object. When the teacher for history
asked him what he thought of the whale that swallowed Jonah,
he replied, "It looks good enough to eat."

Second Child

A *long* time ago the little *fish* of the sea were .... school down under the *waves* safe from dangerous animals. *the* pupil, Jimmie Cod, was *very* studying. He was looking *at* something dangling in front *of* him. He could not *see* his eyes off this *funy* object. When the teacher *sed* history asked him what *colour* thought of the whale *was* swallowed Jonah, he replied, "*He* looks good enough to *eat*."

The first child has grasped the full sense of the passage, his two errors in identifying the original missing words being of minor significance and syntactically acceptable. The responses of the second child reveal only a limited understanding of the meaning of the passage. Some sentences and parts of sentences have been correctly interpreted, but the words inserted in other sentences indicate a deficiency in both semantic and syntactic understanding.

To define comprehension as grasp of meaning or as understanding of the message being communicated, however, is to provide less than a complete description of it. Such a definition reveals nothing of the processes involved in comprehension, nor of possible gradations in the depth of understanding of different readers. The complexity of the reading task, in fact, makes it difficult to arrive at an adequate definition of reading comprehension, as has been recognized for many years; in 1908 Huey argued that

> "to completely analyze what we do when we read would almost be the acme of a psychologist's achievements, for it would be to describe very many of the most intricate workings of the human mind.................."

while E.L. Thorndike in 1917 described reading as

> "a very elaborate procedure, involving a weighing of each of many elements in a sentence, their organization in the proper relations one to another, the selection of certain of their connotations and the rejection of others, and the cooperation of many forces to determine final response."

Although a completely acceptable explanation of reading comprehension has yet to emerge, there is now a considerable degree of agreement about the major processes involved in comprehending written or printed material. These processes are listed below, merging the classifications proposed by Anderson (1972) and Clymer (1968), and proceeding from the lowest to higher levels of complexity:

1. Orthographic encoding, involving the perceptual recognition of printed symbols as letters, groups of letters, words or groups of words
2. Phonological encoding, involving the conversion of words or strings of words into implicit or explicit speech
3. Semantic encoding, in which the reader gets meaning from the words he sees on the printed page, that is, he grasps the author's meaning
4. Testing and recombining of meanings in which the author's message is combined with the understanding and background of the reader
5. Application and extension, in which the author's ideas and values are applied to decisions and actions and extended to new settings.

The first two processes are often subsumed under the label of "decoding"; the last two represent higher levels of comprehension which are not always explicitly delineated, but which include the anticipation of meanings by the reader in his "psycholinguistic guessing game" (Goodman, 1970) as he anticipates "what he will find as he reads further" or thinks "away and beyond what he has comprehended of the author's meaning..." (Goodman, 1966). In the present study, reading comprehension is regarded as involving at least the third level of processing indicated above, that is, comprehension is more than successful decoding and entails actual extraction of the author's meaning.

What Skills Are Involved In Reading Comprehension?

Much attention has been given to this question over the course of the present century, and an impressively large array of "skills" has been proposed. Many of the lists of skills which have been put forward, however, have been of limited value because of their heterogeneity; skills related to the processes used in reading have not been sufficiently distinguished from skills exhibited in the products of reading (e.g. reading to note details or reading for inference), and neither class of skill has been sufficiently distinguished from the procedures employed in the teaching of reading (Robinson, 1966). A rather clearer picture of the skills involved in reading comprehension can be expected if it is recognized from the outset that the skills fall into logically different categories which would appear to represent different levels in the process of comprehension. These categories are described here as perceptual skills, language skills and selective reading skills. Relevant research and theory concerning reading comprehension skills is summarized under the appropriate heading.

Perceptual Skills

Certain types of skills can be regarded as being basic to the reading process. At the perceptual level, a child must obviously have acquired skills of visual discrimination in order to be able to read. It is necessary for him to recognize and distinguish letters and groups of letters or words, to distinguish one line of print from another, and to focus his eyes successively on sequential words or groups of words. As the printed words or groups of words are usually converted to their spoken form, either implicitly or explicitly in the process of comprehension, the child should also have acquired the necessary auditory discrimination skills to recognize and distinguish different phonemes and groups of phonemes, as well as differences in stress and intonation. These visual and auditory perceptual skills are pre-requisites to the comprehension of printed discourse for children of normal vision or hearing. It is by no means certain, however, that all of the children who possess these skills and apply them in reading printed discourse will in fact comprehend what they are "reading".

The influence of perceptual skills on reading comprehension is likely to be important among beginning readers, but to become progressively less relevant among children without sight or hearing impairments as they proceed through the primary school. As the present study is concerned with the reading comprehension skills of children at the upper primary school level, and as most if not all of these children could be assumed to possess the necessary levels of perceptual discrimination, no further analysis of these perceptual skills is undertaken here.

Language Skills

In addition to being able to discriminate sounds and letters and word symbols at the perceptual level, a child needs to acquire language processing skills to extract meaning from those symbols. Such skills can be usefully considered within the three major sub-systems of language commonly employed by linguists - the phonological-orthographic subsystem, the grammatical subsystem and the lexical subsystem (e.g. Ives, 1970; Wilkinson et al, 1974).

From the viewpoint of reading comprehension, the stimulus material consists of the letters, words and other graphic symbols (e.g. punctuation marks and paragraphing conventions) on the printed page. The child has to acquire the skill of associating these graphemes with their corresponding phonemes, i.e. the types of sounds such as vowels, consonants, pauses and pitch which are used in producing utterances (Ives, 1970).
Evidence supporting the occurrence of this initial phonological encoding of printed verbal stimuli is available in experiments on short-term memory (Conrad & Hull, 1964; Baddeley, 1964, Murray, 1967). Examples of these phonological-orthographic skills would include the recognition that the printed symbol "s" has different sounds and functions, that the printed symbols "bat" and "pat" correspond to a voiced and voiceless production of the initial consonant, and that certain sequences of letters such as bp are not allowable sequences in English words.

Research findings indicate that children have largely attained competence in the phonological system of their native language by about the age of 6 years (Ervin & Miller, 1963), but further phonological development may still occur (Carroll, 1971c). There is little precise information available about the degree of mastery of grapheme-phoneme correspondences exhibited by children at different primary school age levels, but the evidence reviewed by Carroll (1971c)suggests that even at the sixth grade level in the primary school, there would be some children with some deficiencies in these phonological-orthographic skills.

Regularities of pattern in two-word and longer sentences uttered by young children indicate that they begin to learn and to apply the implicit rules of their language in their own speech at an early age (Slobin, 1971). Linguists are often impressed with the rapidity with which children acquire and develop their knowledge of the grammatical subsystem of language; Chomsky and Miller (1963) remark on "how an untutored child can so quickly attain full mastery of a language." Although he may well be unable to formulate the explicit grammatical rules governing his production of language, the child quickly absorbs the rules or practices of his native language which relate to such matters as the ways in which particular types of words may be used, the order in which words appear in utterances or in sentences, and the like.

As the child must develop an implicit understanding of these grammatical rules in order to produce acceptable language, his ability to apprehend grammatical relations can be expected to be highly relevant also to his comprehension of language, whether in printed or spoken form. Certainly, a person who is not familiar with the ways in which different classes of words are used and sentences are put together in a language will have great difficulty in understanding it, even if he knows the meaning of individual words. The relevant body of rules in the grammatical sub-system of his language which the child comes to know explicitly or implicitly embraces two broad classes - the rules of syntax, relating to the ordering of words in sentences and paragraphs, and the rules of accidence, relating to the grammatical functions of words and morphemes e.g. the changes required to convert a word from singular to plural, from present to past tense, from noun to adjective, and so on (Wilkinson et al, 1974). It would seem that a good grasp of these language processing rules would facilitate comprehension of printed discourse, and Carroll's (1971b) review of relevant research shows that this proposition would be supported by many studies of the effect of the syntactic structure and "grammaticalness" of material on the comprehensibility and immediate recall of passages. There has been little investigation, however, of the extent to which performance on reading comprehension tests is dependent on grammatical and syntactical knowledge. In one relevant study (Stoodt, 1972), it was found that reading comprehension correlated significantly (r = .42 for 95 fourth grade students, with intelligence test scores partialled out) with comprehension of grammatical conjunctions. But further analysis of the relationship between reading comprehension and ability to apprehend grammatical relations is clearly warranted.

The third sub-system of language is the lexical sub-system, which has to do with the child's knowledge of the words and idioms of the language and their meaning. Reading comprehension will clearly be related to the child's recognition vocabulary, that is, to the number of words which the child can recognize and whose meaning he knows. Numerous studies involving both vocabulary and reading comprehension tests (e.g. French, 1951; Davis, 1968; Clark, 1972) have demonstrated that the two types of test are highly correlated. Deficiencies in vocabulary knowledge are likely to depress the performance of children on reading comprehension tests.

Although language skills have been discussed here within the phonological-orthographic, grammatical and lexical subsystems, it should be stressed that the act of comprehending printed language will draw simultaneously on all three subsystems, which are overlapping and interdependent components of the total language system. (Ives, 1970).

Selective Reading Skills

The third category of skills assumed to be involved in reading comprehension has been incorporated here under the title of "selective reading skills". Probably most of the research which has been undertaken into reading comprehension skills falls within this category. Numerous lists of such skills, involving approximately two hundred skills in some cases, have been developed by educators and researchers in the field of the language arts, largely on the basis of logical analysis of the reading task (e.g. Gray, 1919; Gates, 1935; Burkart, 1945; Gray, 1960; Spache, 1962; Robinson, 1966 and Barrett, 1968). In his 1919 listing, Gray set out eight skills of comprehension, which were (i) to read for the purpose of giving a coherent reproduction, (ii) to determine the central thought or the most important idea of a selection, (iii) to select a series of closely related points and their supporting details, (iv) to secure information which will aid in the solution of a problem or in answering questions, (v) to gain a clear comprehension of the essential conditions of a problem, (vi) to discover new problems in regard to a topic, (vii) to determine the lines of argument which support the point of view of the author, and (viii) to determine the validity of statements. In 1927, Gates developed his Silent Reading Tests (Gates, 1927) to test the skills of (i) reading to appreciate general significance, (ii) reading to understand precise directions, (iii) reading to note details and (iv) reading to predict the outcome of given events. Periodic reviews and restatements of these skills were made over the ensuing fifty years (e.g. Davis, 1944, 1968; Derrick, 1953; Robinson, 1966). By the mid-1960's, Gray and Robinson in their analysis of the reading process were taking reading comprehension to include understanding of the literal meaning of a writer, understanding of the writer's implied meaning, the assessment of the writer's purpose, frame of reference, assumptions and generalizations, the evaluation of the writer's ideas by the reader, and the integration of the writer's ideas and information with those of the reader (Davis, 1972; Gray, 1960; Robinson, 1966). In similar vein, Barrett (Clymer, 1968) developed a detailed taxonomy of the cognitive and affective dimensions of reading comprehension:

1.0 Literal Comprehension

This focuses on ideas and information which are explicitly stated in the selection.

- 1.1 Recognition, requiring location or identification of ideas or information explicitly stated, and incorporating tasks requiring recognition of details, of main ideas, of sequences, of comparisons, of cause and effect relationships and of character traits.
- 1.2 Recall of ideas and information explicitly stated, including tasks requiring recall of details, of main ideas, of sequences, of comparisons, of cause and effect relationships, and of character traits.

2.0 Reorganization, requiring the student to analyze, synthesize, and/or organize ideas or information explicitly stated in the selection.

3.0 Inferential Comprehension

This focuses on inference and conjecture by the student which is based on, but goes beyond, the ideas and information explicitly stated in the selection. The student is required to make inferences about supporting details, main ideas, sequences, comparisons, cause and effect relationships, and character traits and also to predict outcomes and interpret figurative language.

4.0 Evaluation

Evaluation of ideas presented in the selection in relation to external criteria or to internal criteria provided by the reader's experiences, knowledge or values. With respect to the ideas put forward in the selection, the student is required to make judgments of reality or fantasy, fact or opinion, adequacy and validity, appropriateness, worth, desirability and acceptability.

5.0 Appreciation

This relates to the psychological and aesthetic impact of the selection on the reader, and involves the student's emotional response to the content of the selection, his identification with characters or incidents, his reactions to the author's use of language, and to the author's imagery.

There is no doubt that the reading comprehension "skills" involved in these classifications can be fairly convincingly distinguished on a logical basis. Recognizing or recalling the details of a passage may well be a different task from recognizing or recalling the main ideas, and from making inferences about cause and effect relationships or predicting what is most likely to happen next. However, there is an underlying assumption involved in most of these classifications of reading comprehension "skills", viz. that because the tasks differ, the "skills" differs. This is a questionable assumption, as tasks and skills are not necessarily isomorphic. In the measurement of perceptual speed, for instance, the speed with which children can determine whether two stimuli are identical or different may be assessed with pairs of multi-digit numbers, or pairs of words, or pairs of pictures, but although the tasks differ, the attribute being measured may be the same from task to task. Similarly, the recall of sequences of letters presented one letter at a time may be assessed by means of auditorially or visually presented tasks, but both tasks may be measuring the one skill of recalling a sequence of letters from memory rather than two separate skills. A close examination of the types of "skill" postulated in these lists of reading comprehension skills shows that the reader is in fact being asked to read a selection or passage for different purposes, the purpose being indicated to him either by preliminary instructions or practice exercises, or by the form of question he is asked to answer about the passage after he has completed reading it. Thus, he may be required to read for detail, for literal meaning, for the implications of main ideas, for the purpose of predicting outcomes, for the purpose of judging the validity of the author's arguments, or for the purpose of reacting to the author's use of language and imagery. In other words, these different tasks require selective reading of a passage for different purposes, and hence have been described in the present study under the category of selective reading skills. Whether they do in fact represent different skills is a matter for empirical verification, and the relevant research evidence will now be briefly reviewed.

E.L. Thorndike's classic study of 1917 on "Reading as Reasoning: A Study of Mistakes in Paragraph Reading" marked the beginning of experimental studies of reading comprehension. Thorndike's general conclusion from this study was that reading comprehension was largely a process of reasoning in that it involved "the same sort of organization and analytic action of ideas as occur in thinking of supposedly higher sorts" (Thorndike, 1917). Other early investigators became interested in the degree to which reading comprehension tests were associated with abilities thought to be relevant to comprehension such as general intelligence, vocabulary level, organization skill and rate of reading (Gates, 1921; Hilliard, 1924), and carried out extensive studies of correlations between these variables. Correlational studies were also undertaken by later researchers (e.g. Artley, 1944; McCullough, 1957) among tests designed to measure different aspects of comprehension such as identifying main ideas, recalling facts or details, identifying sequence or organization, perceiving logical relations, evaluating arguments and the like. Since correlational studies are inadequate for the purpose of identifying the underlying skills involved in a set of test scores, the findings of these studies are not discussed here.

Most of the experimental investigations of reading comprehension skills have employed the technique of factor analysis, which is appropriate for identifying the skills underlying performance in complex mental tasks.* The results of these studies, and of studies using other acceptable techniques, are summarized in compact form in Table 2.1. Except where indicated otherwise, the studies have been carried out in the U.S.A.

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* This viewpoint has been recently contested, especially with respect to items which might be considered to form a hierarchical set, such as the item types in Davis' tests of reading comprehension (Andrich and Godfrey, 1976).

Table 2.1. Skills identified in experimental studies of reading comprehension tests

AUTHOR, DATE	GRADE LEVEL, N, METHOD OF ANALYSIS	COMPREHENSION SKILLS IDENTIFIED*
Feder 1938	College Sophomore (N=99) Factor analysis (FA) -centroid orthogonal	Factual reading Inferential reading Speed of comprehension
Gans 1940	4-6 (N=417) (FA)-centroid, oblique	Reading ability Detection of relevance/irrelevance in sentences Acceptance of remotely relevant and rejection of fanciful materials
Langsam 1941	College Freshmen (N=100) (FA)-centroid, rotation unspecified	Verbal ability(V), Perceptual ability(P), Word fluency(W), Seeing relationships. A number facility factor(N) was also obtained in this study. (Reinterpretation by Davis (1972), confirmed by a varimax - rotated max. likelihood factor analysis of the data undertaken for the present study): Verbal reasoning Speed of mental operation or speed of reading Word knowledge (Quantitative reasoning)
Conant 1942	10-12 (N=256) Principal components	General comprehension, linguistic Comprehension and organization of specific facts (Quantitative) (Reinterpretation by Davis (1972): Word knowledge Apprehension of main thought of passage (Quantitative facility)
Davis 1944	College Freshmen (N=543) Principal components	Knowledge of word meanings Reasoning in reading Literal sense meaning Following the structure of a passage Recognizing mood and literary techniques of writer (Thurstone (1946) reanalysed Davis' data with communalities in diagonal cells, and obtained only one factor - general reading ability)
Hall and Robinson 1945	College Freshmen (N=100) (FA)-centroid, orthogonal	Attitude of comprehension accuracy(?) Rate of inductive reading Verbal or word meaning Rate for unrelated facts (Chart reading skill)
Anderson 1949	11, Scotland (N=500) FA-centroid, bipolar	Vocabulary (Intelligence) Analysis e.g. grammar, spelling vs Synthesis e.g. sentence structure, punctuation
Derrick 1953	College Freshmen (N=223) Spearman two factor, Holzinger bi-factor	Analysis of reading comprehension tests designed to measure - a) The ability to answer factual questions b) The ability to read-between-the-lines c) The ability to make critical judgements, produced a single factor called 'General reading ability'. No special skills are associated with variations in length of passage. [A reanalysis (max. likelihood, varimax) for the present study suggests that (a) factual and (b) inferential are indistinguishable but that (c) judgemental, is a separate skill.]

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* Factors arising from studies which included other types of tests in addition to verbal tests are indicated in brackets.

Hunt 1957	University Students (N=5457) (FA)-centroid, principal axes (N=370) Differential item analysis	General comprehension Word knowledge Following the organization of a passage
Vernon 1962	College Britain, (N=108) USA (N=75) (FA)-centroid,orthogonal	Vocabulary Comprehension
Holmes and Singer 1966	9-12 (N=400) (FA)-centroid,varimax	Audiovisual verbal symbolic-reasoning Phonetic word-structure Speed of visual-verbal perception Other factors irrelevant to reading comprehension (Factors interpreted by Davis (1972) to measure general verbal knowledge, verbal perception ability, speed of mental operation)
Davis 1968	12 (N=988) Uniqueness analysis(U), Principal Components (PC), Varimax	Recalling word meanings(U,PC) Drawing inferences about the meaning of a word from context (PC) Finding answers to questions answered explicitly or in paraphase(U) } (PC) Weaving together ideas in the content } (PC) Drawing inferences from the content(U,PC) Recognizing a writer's purpose, attitude, tone and mood(U) Following the structure of a passage(U)
R.L. Thorndike 1971, 1973	Reanalysis of Davis 1968 data Principal components, reliability coefficients in diagonals	Reasoning (embracing both Word Knowledge and reasoning in reading)
Spearritt 1972	Reanalysis of Davis 1968 data Maximum likelihood FA, varimax, oblique	Recalling word meanings {Drawing inferences from the content Recognizing a writer's purpose, attitude, tone and mood Following the structure of the passage} (Although the three bracketed skills were differentiable, they were highly intercorrelated, suggesting that, except for word knowledge the tests largely measure one basic ability, e.g. reasoning in reading)
Clark 1972, 1973	7 (N=198M, =163F) (Western Australia) Factor analysis (FA) - principal axis factom varimax, promax Smallest space analysis (SSA)	Word knowledge (FA, SSA) Fluency (FA, SSA) Memory for semantic units (FA) Memory for semantic relationships (FA) Reading comprehension (FA) Reasoning (FA, SSA) Other factors relating to listening comprehension or accounting for small proportion of variance: Recall and recognition of explicit meaning (SSA) Interpreting tables (SSA) Using reference sources (SSA)

Granting the difficulties of interpretation arising from the diverse structure of some of the early test batteries, the list of comprehension skills set out in Table 2.1 suggests that there is strong evidence that a student's performance on reading comprehension tests depends largely on the level of his vocabulary or knowledge of word meanings and on his 'general reading ability', i.e. his ability to extract meaning from and discern relationships within the passage as a whole. There is strong evidence also from those studies in which measures of speed of reading were included, that students differ in the rate at which they can read with comprehension.

While some studies indicate that there are separate skills involved in reading for facts or literal meaning, and in reading to draw inferences or to grasp implied meaning, this distinction is not consistently maintained. It may well be a minor distinction which can be subsumed within a more comprehensive skill described as "reasoning in reading" (Thorndike, 1971; Spearritt, 1972). Other identified skills such as following the structure of a passage, or recognizing a writer's purpose, attitude, tone and mood also appear to be minor distinctions, or minor identifiable aspects of a student's general ability to read with understanding or to reason in reading.

It needs to be recognized, however, that the studies summarized in Table 2.1 relate predominantly to students at the senior secondary school or college levels, and that reading comprehension skills may be more readily distinguishable among primary school children. A further characteristic of the studies in Table 2.1 is that they were very largely based on reading comprehension tests presented in multiple-choice format, the main exceptions being the studies of Vernon (1962) and Clark (1973), which employed creative response or recall type tests as well as multiple choice tests. The preponderance of multiple-choice type reading comprehension tests in these studies could have had an effect on both the number of reading comprehension skills identified and the type of skill identified; such tests may make greater demands on reasoning, for instance, since the child has to consider not only the relationships existing within the passage itself, but also the relative merits of the various options within the questions relating to the passage. In attempting to identify the skills involved in reading comprehension, therefore, evidence from other types of reading comprehension test needs to be considered.

"Cloze" tests of reading comprehension (Taylor, 1953) have become increasingly prominent over the last twenty years and are now in widespread use. In the standard form of the cloze test, every n^{th} word of a passage is deleted, and the child is required to write in the missing word. Since context and linguistic cues can be used to help identify the missing word, it might be expected that this type of test would measure additional skills to those measured by multiple-choice reading comprehension tests, or at least the same skills in different degrees. This expectation was fulfilled in one study with college students, in which Weaver and Kingston (1963) identified a "redundancy utilization" factor on which only the cloze tests in their battery were represented. In general, however, cloze tests have been found to be fairly highly correlated with other multiple-choice reading comprehension tests, reviews of the empirical evidence (e.g. Rankin, 1965) suggesting that the typical level of correlation would be of the order of .7; for children in Grades 4 and 5, Bormuth (1967) found the correlation to be .95. Bormuth's (1969) factor analytic study of nine cloze tests and six multiple-choice tests based on the same passages indicated that for 150 children in Grades 4, 5 and 6, the cloze tests were measuring the same types of skills as the multiple-choice tests.

In the chunked type of reading comprehension test (Carver, 1970), a passage is presented to the subject, and then reproduced in chunks - consisting of a clause, phrase or word - as multiple-choice items. In each question the child is required to select the option in which the meaning has been changed from the original passage, without referring back to the passage. While this type of test might be expected to make more demands on memory than multiple-choice and cloze tests of reading comprehension, little evidence is yet available on the skills measured by chunked tests.

Vernon (1962) found that "creative-response" tests of reading comprehension in which the subject answers in his own words questions about the reading selections, did not involve different abilities from those measured by multiple-choice tests. Recall-type tests of reading comprehension were also shown by Clark (1973) to be largely measuring the same basic factors as multiple-choice tests, though they involved specific skills in part.

The evidence yielded by cloze, chunked and creative response type reading comprehension tests does little to disturb the picture which emerged from the studies of multiple-choice tests. In effect, experimentally distinguishable skills measured by existing tests of reading comprehension seem largely to comprise vocabulary or knowledge of word meanings, speed or rate of reading and the ability to extract meaning from the passage as a whole. Translated into practical terms, this evidence would suggest that three measures would be sufficient to provide a profile of a student's proficiency in reading comprehension - a vocabulary test, a speed of reading test, and a test requiring the student to read printed passages and to answer questions about them, perhaps subdivided to provide separate measures for literal meaning and implied meaning. Several writers, however, (e.g. Carroll, 1969, 1972; Bormuth, 1970; Anderson, 1972) have taken the view that existing comprehension tests tap a congeries of skills, and that more explicit definition of the component skills of comprehension and more careful test construction would indicate much more clearly those aspects of comprehension in which a child was proficient and those in which he showed some deficiency.

Can Reading Comprehension Skills be measured more precisely?

Just how precisely one might wish to measure reading comprehension skills would depend on the age and educational level of the groups of interest. Fine-grained measurement would be unnecessary among mature readers, and reading comprehension tests which depended heavily on inferential or reasoning abilities may be entirely appropriate at high school or college level especially if the purpose of the test is to assess potentiality for later academic success. More precise measures of the skills would be useful at those levels of schooling at which students were not yet mature readers, which would include lower secondary school levels for some students.

As outlined in Chapter 1, Carroll (1969, 1972) has argued for the development of separate measures of reading comprehension, one assessing the child's simple or sheer comprehension of the literal sense of passages, the other assessing his proficiency in drawing inferences about the deeper meanings implied in passages. It is an important question, in his view, to determine whether tests of comprehension can be constructed which do not require inferential thinking. Bormuth (1970) and Anderson (1972) also take up the question of the measurement of comprehension of achievement on a somewhat broader front, and call for a closer relation between the material contained in the instruction or printed passage and the form of the item used to test whether the material has been understood. Bormuth's scheme was designed to overcome the "primitive" test construction procedures arising out of the subjective judgment of the test writer as to what form of question and what content was suitable for assessing whether the item of instruction had been understood. In place of these procedures, he advocated an operational approach to item writing. This involves the prior analysis and labelling of the structures underlying the instruction to provide statements or topic sentences which can be grammatically and/or semantically transformed according to specified rules to yield items directly related to the particular segment of instruction. For example, the information contained in the sentences "(A) Joe broke his arm. (B) He was riding. (C) He fell off his horse" would lead, after successive transformations to questions such as "What occurred during Joe's riding?, When did Joe's falling off his horse occur?, What caused the breaking of Joe's arm?", and so on. Anderson was also concerned with methods of developing questions which would elicit responses which would indicate exactly what a person has learned from a segment of instruction. He argued that correct responses to verbatim or transformed verbatim questions did not ensure that the material had been actually comprehended, and that paraphrase or transformed paraphrase questions were necessary to ensure this. While the approaches of Bormuth and Anderson were not specifically directed at the measurement of reading comprehension, their proposals were particularly relevant to the measurement of what Carroll (1972) referred to as simple or pure or sheer comprehension. If reading comprehension skills could be measured more precisely, tests constructed according to their criteria might be expected to assist in achieving this goal.

Skill Models of Reading Comprehension

Various types of models have been proposed in connection with the empirical identification of the skills involved in reading comprehension. One set of possible models was put forward by Chapman (1969) to represent three different theories of reading comprehension:

(i) The uncorrelated skills theory which postulates that reading comprehension involves a set of uncorrelated or isolated skills which are learned and used independently,

(ii) The global-skill theory which postulates that reading comprehension involves only one global ability,

(iii) The hierarchical skills theory which postulates that reading comprehension involves separate but correlated skills ranging from simple to complex, the latter including the former.

Davis (1972) argues that experimental data do not support the uncorrelated skills or the global skill model, and that while the data are not inconsistent with the hierarchical skills model, they do not require that proficiency in the simple skills is pre-requisite to proficiency in the more complex skills.

A most comprehensive discussion of comprehension skill models has been presented by Clark (1972). He identifies five types of model:

(i) The dimensional model which seeks to establish the underlying skills, separate but not necessarily uncorrelated, which are involved in reading comprehension,

(ii) The hierarchical model, in which the more complex skills depend upon the attainment of proficiency in the simpler skills,

(iii) The morphological model, which attempts to fit reading comprehension skills into Guilford's Structure-of-Intellect model, a three-dimensional classification of intellectual abilities in terms of the mental operations required, the content of the stimulus material, and the product or type of mental structure involved,

(iv) The facet model, which seeks to determine the extent to which a set of tests can be arranged simultaneously in terms of their degree of complexity and the types of skill involved,

(v) The psycholinguistic model, incorporating the phonological, syntactical and lexical or semantic sub-systems of language, as outlined earlier in this chapter.

Clark's (1973) study of the hierarchical structure of reading and listening comprehension skills incorporated aspects of most of these models, and indicated that the pattern of skills involved in comprehension tests could be identified with some success by the dimensional, hierarchical and especially the facet model. The present study places rather more emphasis on the linguistic competence of students in phonological, syntactical and lexical skills (insofar as their competence can be reasonably estimated by their performance on tests of these skills) in relation to their linguistic performance in a wide range of types of reading comprehension test. It seeks also to explore the feasibility of undertaking more fine-grained measurement of reading comprehension skills, particularly from the point of view of developing separate measures of simple comprehension and of inferential comprehension. It is thus based on a dimensional and psycholinguistic model of reading comprehension skills, but the techniques of analysis employed in the study - factor analysis and to a smaller extent, scale analysis - allow also for some testing of the applicability of the hierarchical model to the postulated skills. The study is thus concerned with the processes as well as the products of comprehension, with the phonological-orthographic, syntactic and semantic inputs to comprehension (linguistic competence) as well as the outputs or scores on reading comprehension tests (linguistic performance). This approach to the identification of comprehension skills was considered to be well suited to a study concerned with the development of practical measures of reading comprehension skills which would provide necessary diagnostic information with as few tests as possible.

CHAPTER III

AN EXPERIMENTAL STUDY OF READING COMPREHENSION SKILLS

It is apparent from the previous chapters that although reading comprehension tests have been in widespread use for many years, there is still considerable uncertainty about the skills involved in reading comprehension and about what is actually measured by reading comprehension tests. The experimental study described in this chapter set out to answer three main questions:

1. What are the components of reading comprehension?
2. What skills are being measured by different types of reading comprehension test?
3. Is it practicable to assess comprehension without at the same time assessing a person's inferential abilities?

In the course of developing instruments for use in the main study, some minor studies of various aspects of comprehension were also carried out.

A. DESIGN OF STUDY

The main study was designed as a factor analytic study, as factor analysis is generally accepted as an appropriate experimental technique for identifying the skills underlying performance in complex mental tasks. It employed a wide variety of measures of reading comprehension, including various forms of tests which have been used to assess reading comprehension. It also comprised measures of the major components of language which appear to influence comprehension, namely phonological-orthographic competence, grammatical and syntactical knowledge, and lexical knowledge. Reference tests in reasoning and in perceptual speed were included in the study to indicate the extent to which performance on reading comprehension tests might be dependent upon such abilities.

The experimental study was intended to be of an exploratory nature, seeking answers to the questions outlined above. It was cast within the framework of the dimensional and psycholinguistic models referred to in Chapter 2, but did not set out to test a set of highly specific hypotheses. The underlying model was a simple one. It was hypothesized that to be able to read with comprehension, children would need to have some knowledge of the relation between printed word symbols and their corresponding sounds, the ways in which words were put together to form sentences, and the meanings of words. For more complex reading material, if perhaps not for simple material, they would need to be able to think about the meaning and implications of the material and draw inferences from it. Different types of reading comprehension test might be expected to tap different skills in different degrees.

The translation of this model into a factor analysis form required the inclusion of several tests of each of these hypothesized skills to define the factors which were expected to emerge in the experimental data. Thus, phonological tests were included to define a "phonological" factor, tests of grammatical knowledge to define one or more grammatical or syntactic factors, vocabulary tests to define a lexical factor, simple comprehension tests a comprehension factor, reasoning tests a reasoning factor and speed tests a perceptual speed factor. Predictions were made of the expected factor composition of different types of reading comprehension test, arising largely from the way in which they were constructed.

Table 3.1 shows the expected factor composition of all the tests employed in the study and thus provides an overall summary of the hypotheses under investigation. Examples of hypotheses implicit in the table would be that tests of syntactic comprehension measure grammatical and lexical competence but not reasoning abilities; tests of reading comprehension involving the understanding of implicit information will have higher loadings on a reasoning factor than those calling for the understanding of explicit information; cloze tests of reading comprehension will have higher loadings on grammatical and syntactic factors than other types of reading comprehension tests; and so on.

Table 3.1* List of Tests and their Expected Factor Composition

TESTS	Phonological-Orthographical Competence	Knowledge of Grammatical Functions	Punctuation	Syntactic Comprehension	Vocabulary Knowledge	Reasoning	Reading Speed	Perceptual Speed
MEASURES OF PHONOLOGICAL -ORTHOGRAPHIC COMPETENCE								
P1. Word Sounds	XX							
P2. Finding Rhymes	XX							
P3. Hidden Words	XX				X			
P4. Word Attack	XX				X			
MEASURES OF GRAMMATICAL OR SYNTACTIC COMPETENCE								
(a) Grammatical Functions of Words or Morphemes								
G1. Word Uses	XX	XX		X	X			
G2. Linguistic Markers	XX	XX		X	X			
G3. Punctuation A.	XX	X	XX	XX	X	X		
G4. Punctuation B.	XX	X	XX	XX	X	X		
(b) Knowledge of Syntactical Structure								
(i) Measures of Word and Sentence Order								
G5. Scrambled Sentences	XX	X		XX	X			
G6. Combining Sentences	XX	X		XX	X			
(ii) Measures of Syntactic Comprehension								
G7. Comprehension of Sentence Structures	XX	X		XX	X			
G8. Comprehension of Anaphoric Expressions	XX	X		XX	X			
G9. Embedded Sentences	XX	X		XX	X			
G10. Recovery of Deep Structure	XX	X		XX	X			
G11. Ambiguous Sentences	XX	X		XX	X			
MEASURES OF LEXICAL COMPETENCE								
L1. Reading Vocab. no context	XX				XX			
L2. English Picture Vocab. Test	XX				XX			
L3. Context REading Vocabulary	XX				XX			

Table 3.1* (continued) List of Tests and their Expected Factor Composition

TESTS	HYPOTHESIZED FACTORS							
	Phonological-Orthographical Competence	Knowledge of Grammatical Functions	Punctuation	Syntactic Comprehension	Vocabulary Knowledge	Reasoning	Reading Speed	Perceptual Speed
TESTS OF READING COMPREHENSION								
C1. N.S.W. Basic Skills Reading Literal	XX			XX	XX	X		
C2. N.S.W. Basic Skills Reading Implied	XX			XX	XX	XX		
C3. Multiple Choice Reading Comp. (Equated)	XX			XX	XX	XX		
C4. Cloze Reading Comp. (Equated)	XX	XX	X	XX	XX	X		
C5. Chunked Reading Comp. (Equated)	XX			XX	XX	X		
C6. Comprehension of Questions	XX	X		XX	XX	X		
C7. Comprehension of Statements	XX			XX	XX			
C8. Following Printed Instructions A.	XX			XX	X			
C9. Following Printed Instructions B.	XX			XX	X	X		
C10. Comprehension of Explicit Information	XX			XX	XX	X		
C11. Comprehension of Implicit Information	XX			XX	XX	XX		
C12. Reading to Note Details	XX			XX	XX	X		
C13. Reading for Inference	XX			XX	XX	XX		
MEASURES OF REASONING								
R1. Letter Grouping						XX		
R2. Progressive Matrices, A+B						XX		
R3. Progressive Matrices, C.						XX		
R4. Progressive Matrices, D.						XX		
R5. Progressive Matrices, E.						XX		
R6. Reasoning	XX			XX	X	XX		
R7. Verbal Intelligence	XX			XX	XX	XX		
MEASURES OF PROCESSING SPEED								
S1. Speeded Cloze Reading Comp. (Equated)	XX	XX	X	XX	XX	X	XX	
S2. Chapman-Cook Speed of Reading	XX			XX	XX		XX	
S3. First Digit Cancellation								XX
S4. Letter A								XX

* Two-cross entries in the table indicate that the test is hypothesised to have a high loading on a factor, one cross indicates that the expected loading of the test is moderate but significant, and a blank space indicates that the expected loading is not statistically significant.

For the kind of hypothesized factor pattern outlined in Table 3.1, an orthogonal rotation by the normal varimax method was selected as a suitable form of factor analysis.

The study was undertaken with children at the Grade 6 level, since such children could be expected in most cases to have mastered the decoding skills involved in reading, and to have had experience with most of the syntactic features of the English language.

In a study of reading comprehension, it seemed appropriate to make allowance for characteristic differences between the sexes in language performance and between the performance of children drawn from areas of contrasting socio-economic status. From the point of view of the design of the study, this requirement was met by nominating samples of sufficient size to allow separate factor analyses to be carried out for boys and girls within both lower and middle socio-economic class levels.

In keeping with the purposes of the study, special attention was given to the selection of passages and items for the tests of reading comprehension. Earlier factorial studies of comprehension have taken little or no account of the linguistic features of the passages used to assess comprehension. Yet it is likely that estimates of a person's level of comprehension would vary with the linguistic complexity of the passages employed - their vocabulary load, grammatical complexity, sentence length, idea density, noun frequency, Latin suffix-density and the like. A convenient source of passages which are similar in level of linguistic complexity is the Miller-Coleman Readability Scale (Miller and Coleman, 1967, Aquino, 1969), which has been shown to yield difficulty gradings for passages which correlate quite highly with particular linguistic indices of difficulty. Passages of similar difficulty levels and of the same length (150 words) were selected from this scale for use in those reading comprehension tests whose factor patterns were to be closely compared.

The selection of items for most of the reading comprehension tests took account not only of difficulty and item-total score discrimination indices for trial groups of Grade 6 children but also of the extent to which the items could be answered correctly by children who had not read the passages on which the items were based. Kerfoot (1964) has shown that many questions in reading comprehension tests can be answered correctly by students who have not read the stimulus passages. While such questions may measure skills which are helpful in reading, they cannot be regarded as a valid indication of the extent to which a child has understood the material specifically presented in the stimulus passage. Items were therefore selected according to the general principle adopted by Marks and Noll (1967), viz. that there should be only a small proportion of subjects who can respond correctly to an item prior to the presentation of the stimulus passage.

Except for the reference tests for reasoning and speed of processing, and for some of the phonological-orthographic tests, all tests were pre-tested on trial samples of Grade 6 classes, and the selection of items and fixing of time limits was based on the information obtained from the pre-tests. Relevant details are given in Appendix A.

B. THE TEST BATTERY

The tests included in the battery are described below under six major headings:

(i) measures of phonological-orthographic competence
(ii) measures of grammatical or syntactical competence
(iii) measures of lexical competence
(iv) tests of reading comprehension
(v) measures of reasoning
(vi) measures of speed of processing printed verbal material.

The sources of the tests and the details of test construction are presented in Appendix A, but are given in brief form in this chapter when essential to the context. Where relevant, the time allowed for working each test is also indicated.

I. MEASURES OF PHONOLOGICAL-ORTHOGRAPHIC COMPETENCE

The translation of written symbols to sound, of orthographic forms to existing phonological forms, is a basic operation in the reading process and "probably the only language skill unique to reading" (Venezky, 1967). Failure to develop or slowness in reaching proficiency in this decoding skill could be expected to retard performance in reading comprehension. While it would be hoped that very few children would have decoding difficulties by the time they reach Grade 6, such difficulties could be a root cause of poor comprehension.

Knowledge of phoneme-grapheme relationships was assessed at the word identification level, as the purpose of mastering the simpler phonemic and graphemic units is to assist in the identification of larger units such as words. Measures of phonological-orthographic competence which were amenable to group testing were selected; the size of the sample made it impracticable to ask children individually to give the spoken counterpart of a printed word symbol, and to require them to give the written representation of a spoken word would have tapped abilities other than their knowledge of phonological-orthographic correspondence.

Four measures were included in the battery to test knowledge of phonological-orthographic correspondence.

1. Test P1. Word Sounds. (Sound to Symbol Recognition) (30 items)

Purpose:	To assess knowledge of sound to symbol correspondence.
Task:	Select which one of three words has been presented by speaker on tape recording,

e.g. swims: swim swing swims.

2. Test P2. Finding Rhymes (44 items, 6 minutes)

Purpose:	To assess knowledge of symbol to sound correspondence.
Task:	Select one of four printed words that rhymes with a given word, e.g.

PART shirt heart party past

3. Test P3. Hidden Words (29 items, 5 minutes)

Purpose:	To assess knowledge of symbol to sound correspondence by selecting word or phrase of equivalent meaning.
Task:	Select from four alternatives the word or group of words which has the same meaning as the hidden word, e.g.

apl	a month of the year	a kind of fruit
	lazy	a boy's name

4. Test P4. Word Attack (19 items)

Purpose: To assess proficiency in recognizing correct pronunciation of unfamiliar printed words, i.e. symbol-sound relationships.

Task: Indicate whether each of three different pronunciations presented by a speaker (phonetician) on a tape recording is the correct or an incorrect way of pronouncing the word printed on the test paper e.g.

	1	2	3
recalcitrant	r̀ɛkælsɪtrənt	ríkæ lsitrənt	ríkɔlkɪtrənt

II. MEASURES OF GRAMMATICAL OR SYNTACTICAL COMPETENCE

Ability to apprehend grammatical relations is considered to be a prerequisite of comprehension (e.g. Carroll, 1969). As well as knowing the meaning of individual words in a language, a person needs to know how different types of words are used in that language and the ways in which they are put together to form sentences, in order to understand the language. The native speaker of a language acquires through imitation, instruction and use a knowledge, explicit or implicit, of a large body of rules which relate the form in which the language is expressed to the meaning intended to be conveyed.

Little information is available about the extent to which a child's understanding of printed passages depends on his knowledge of specific grammatical or syntactic features of those passages. Since most aspects of grammar and syntax are likely to be involved in comprehension, a wide range of measures of grammatical or syntactical competence was included in the test battery. Some are concerned with the grammatical functions of words or morphemes, while others relate to word order in sentences.

(a) Grammatical functions of words or morphemes

Tests of the understanding of the functions performed in sentences by particular classes of words such as nouns, verbs etc. were considered preferable to tests requiring identification of formal parts of speech, which could have been affected by differing levels of experience of children with the latter task.

Two measures of the grammatical functions of words or morphemes were employed, together with two punctuation tests which are included in this section because they deal with grammar related conventions of written language. Two passages were used for punctuation in order to define a potential punctuation factor.

5. Test G1. Word Uses (21 items, 6 minutes)

Purpose: To assess proficiency in perceiving correct uses of words which can be used to serve different grammatical functions, i.e. as different parts of speech.

Task: Indicate whether the underlined word is used correctly or not, e.g.

It is very blossom outside.	Right	Wrong
We will paint in class today.	Right	Wrong
("Blossom" could be used correctly as a noun or a verb.)		

6. Test G2. Linguistic Markers (20 items,10 minutes)

Purpose: To assess proficiency in using linguistic signals such as particular words or forms of expression to extract meaning from sentences in the absence of meaningful external referents.

Task: Answer the question following each sentence, e.g.

Jim baxed the tuv which quiged.
Question: Which tuv did Jim bax?
Answer: . . . .

7, 8. Tests G3, G4. Punctuation A, B. (A: 24 items; B: 28 items) (20 minutes)

Purpose: To assess proficiency in inserting appropriate punctuation marks in unpunctuated passages.

Task: Rewrite two short passages, putting in the proper punctuation marks i.e. capital letters, full stops, commas and other kinds of punctuation.

(b) Knowledge of Syntactical Structure

It would be possible through the symbols and rules of phrase structure grammar to assess a mature language user's knowledge of syntactic structure without dependence on semantic meaning. It is difficult, however, to ascertain the extent of a primary school child's knowledge of acceptable ways of arranging words and classes in sequences in the absence of a semantic context.

Knowledge of syntactic structure has therefore been assessed within a semantic context, with the result that most of the tests shade into the area of comprehension, albeit pure comprehension.

(i) Measures of Word and Sentence Order

9. Test G5. Scrambled Sentences (18 items, 30 minutes)

Purpose: To assess knowledge of acceptable ways of arranging words in sentences.

Task: Rewrite scrambled or disarranged sentences to make a proper meaningful sentence e.g.

Brought a was standstill traffic to.

10. Test G6. Combining Sentences (18 items, 18 minutes)

Purpose: To assess proficiency at forming complex or compound sentences from two or more simple sentences, and thus knowledge of syntactical structure.

Task: Select the best of four forms of expressing a complex sentence. e.g.

*John is in the store. It is a hardware store. Fred is also in the store. They are buying tools.

(A) John is buying tools from Fred in the hardware store.
(B) John is buying hardware tools from Fred in the store.
(C) John and Fred are buying tools in the hardware store.
(D) John and Fred are buying hardware tools in the store.

(ii) Measures of Syntactic Comprehension

Tests G5 and G6 were concerned with the application of syntactical rules but did not require the child to indicate directly that he had grasped specific items of information. Other measures of knowledge of syntactical structure call for understanding of such information, and are therefore grouped together under the general heading of Syntactic Comprehension.

11. Test G7. Comprehension of Sentence Structures (56 items, 20 minutes)

Purpose: To measure sheer comprehension of information conveyed in basic sentence structures.

Task: Answer the question following each sentence, e.g.

The dog ate the biscuits which were on the table.
Question: What ate the biscuits?
Answer: . . . .

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Source: Sentences were developed to conform to sentence types selected from those listed in the transformational analysis section of Menzel's classification (Bormuth, 1970).

Four types of questions were employed, viz. rote questions, transform questions, semantic substitute questions and compound questions (Bormuth, 1970) as described in Appendix A. Most questions required one or two words or short phrases as answers.

12. Test G8. Comprehension of Anaphoric Expressions (48 items, 25 minutes)

Purpose: To assess proficiency in interpreting anaphoric expressions, i.e. pronoun-like structures which shorten or substitute for expressions usually antecedent to them.

Task: Answer the question following each group of sentences.

e.g. The new car had arrived. It was parked on the road.
Question: What was parked on the road?
Answer: . . . .

e.g. Mr. Smith and Mr. Hobbs were the owners of the farm. The latter was holding the lamb.
Question: By whom was the animal being held?
Answer: . . . .

Source: Sentences were developed using the 19 types of anaphora set out in Menzel's classification (Bormuth, 1970) or in the study of children's comprehension by Bormuth et al (1970). Four types of questions were employed, viz. rote, transform, semantic substitute and compound questions as described in Appendix A. Most questions required one or two words or short phrases as answers.

13. Test G9. Embedded Sentences (20 items, 15 minutes)

Purpose: To assess proficiency in understanding involved syntactical constructions.

Task: Answer the question which follows each sentence

e.g. Running along the bank the children were sliding on the mud.
Question: Which children were sliding on the mud?
Answer: . . . .

The above stimulus sentence is a left-branching embedding. The alternative forms would read:

The children who were running along the bank were sliding on the mud. (Centre-embedded)
Sliding on the mud were the children who were running along the bank. (Right-branching).

Source: Original. Included for the purpose of exploring a suggestion made by Carroll (1971b) that children who can follow increasingly involved syntactical constructions might be expected to show greater proficiency in reading comprehension. To allow for increasing syntactic difficulty, sentences were developed with centre-embedded and right-branching as well as left-branching clauses, as Schwartz, Sparkman and Deese (1970) had found that there was a rapid decline in comprehensibility as sentences were extended to include centre-embedded or right-branching clauses, but no decline for left-branching clauses.

14. Test G10. Recovery of Deep Structure (30 items, 22 minutes)

Purpose: To measure understanding of the underlying meaning of a sentence.

Task: Fill in the blank spaces in the second sentence of a pair to make the two sentences have the same meaning e.g.

For the girl to leave is what the boy would like.
What the _____ would like is for the _____ to leave.

15. Test G11. Ambiguous Sentences (14 items, 7 minutes)

Purpose: To assess proficiency in perceiving the various interpretations which can be placed on ambiguous sentences by selecting appropriate line drawings of situations.

Task: From four line drawings on a page, select those which represent correct meanings of the sentence given at the top of the page. e.g.

They fed her dog biscuits.
He turned round the signpost.
They enjoyed watching the eating of the fish.

III. MEASURES OF LEXICAL COMPETENCE

A person's lexical competence comprises his knowledge of words, idioms, and morphemes in the language. It would be possible to assess knowledge of morphemes separately, but such knowledge is probably assessed adequately though incidentally by vocabulary tests containing a reasonable sampling of words from the language. Knowledge of idiomatic expressions can also be tested incidentally, particularly by tests which assess knowledge of words presented in context.

One issue to be considered in the measurement of vocabulary is whether different forms of vocabulary test measure the same or different abilities. In another study undertaken with Grade 6 children, the author has shown that multiple-choice vocabulary tests, requiring identification of the meaning of either words in isolation, or words in context, and recall type vocabulary tests requiring the insertion of an appropriate word, all measure the same ability (Spearritt, 1971). It was therefore considered appropriate to measure vocabulary knowledge in multiple choice format.

16. Test L1. Reading Vocabulary, no context (30 items, 6 minutes)

Purpose: To assess knowledge of reading vocabulary.

Task: Select the word or phrase which has the same or most nearly the same meaning as the stimulus word, e.g.

ship 1. jump 2. boat 3. tree 4. stick 5. sail

17. Test L2. English Picture Vocabulary Test (32 items)

Purpose: To provide a measure of vocabulary knowledge based on a response to pictures instead of printed words.

The test could be expected to serve as a screen test for children who knew the meanings of words but who were unable to decode written or printed letter symbols.

Task: After listening to the word announced by the tester, cross out that one of a set of four pictures to which the word refers.

18. Test L3. Context Reading Vocabulary (24 items, 20 minutes)

Purpose: To assess knowledge of reading vocabulary.

Task: Read a passage for comprehension, then select from one of four options the word which has most nearly the same meaning as a nominated word in the passage.

Simple example:

> Passage. Thumper is a large friendly dog. He likes to chase the cars and trucks. His master growls at him for doing this.
>
> Question. In this story what does the word large most nearly mean?
>
> (A) old (B) hairy (C) small (D) big

IV. TESTS OF READING COMPREHENSION

Several types of reading comprehension test were included in the test battery as one of the main purposes of the study was to determine the abilities being measured by the different types of test. The tests differed from those described earlier as syntactic comprehension tests in that they demanded understanding of more than a transformation of a stimulus sentence.

For the reasons advanced in the first section of this chapter, special consideration was given to the construction and adaptation of the reading comprehension tests, particularly those of the multiple-choice type. In the course of constructing these tests, the test questions were applied to groups who had not read or heard the passage so as to ensure that the questions finally selected for the test did in fact measure comprehension of the material presented in the stimulus sentence or passage.

19, 20. Tests C1, C2. New South Wales Basic Skills Reading Test (Adapted)
(35 minutes) A. Literal Meaning (14 questions from 5 passages)
B. Implied Meaning (11 questions from 3 other passages)

Purpose: To measure reading comprehension by seeking answers to multiple-choice questions based on passages read. The test was included to represent the standard type of reading comprehension test employed in schools.

Task: Read a passage for comprehension, then select from one of four options the correct answer to questions relating to the literal meaning or implied meaning of aspects of the passage.

Simple example:

Passage. Thumper is a large friendly dog. He likes to chase the cars and trucks. His master growls at him for doing this.

Question 1. (Literal meaning)

What does Thumper like to do?

(A) Watch cars and trucks
(B) Bite people
(C) Chase after cars
(D) Ride in trucks

Question 2. (Implied meaning)

What does Thumper's master think about his dog's game?

(A) He doesn't like it.
(B) He doesn't think about it.
(C) He is pleased about it.
(D) He takes no notice of it.

Source: Adapted from N.S.W. Basic Skills Reading Test R, Grade 6, Forms X and Y, after elimination of questions which could be answered by substantial proportions of children who had not seen the passages.

The next three tests (21, 22 and 23) represented three different forms of reading comprehension test - the multiple-choice form, the cloze form and the chunked form. To allow a more precise comparison of the types of skills tapped by each form, it was necessary to control certain of the passage characteristics, especially their length and their linguistic complexity. As explained earlier, a convenient, practicable and partially validated method of achieving such equation has been developed through the use of the cloze procedure by Miller and Coleman (1967) in the form of the Miller-Coleman Readability Scale (MCRS) which consists of thirty-six 150-word passages.

The immediate value of this scale for the present study was that passages of very similar difficulty, as judged by the various indices reported by Aquino (1969), could be used as stimulus passages for different forms of reading comprehension test. Aquino's indices of the order of difficulty of the passages, which were based on the responses of mature language users, were accepted as adequate for the purpose of the study.

Six consecutive passages were selected from the Miller-Coleman Readability Scale and were found from preliminary trials to be of suitable content and difficulty level for Grade 6 children. One was used to develop a speeded form of cloze test, which will be described later. The other five will be identified according to the particular form of reading comprehension test in which they were employed. Two passages were required in the multiple-choice form and in the chunked form of the test to generate a sufficient number of items to achieve a reliable test.

21. Test C3. Multiple-choice Reading Comprehension (Passage equated) (20 items, 12 minutes)

Purpose: To assess performance on a multiple-choice reading comprehension test for purposes of correlating this with performance on cloze and chunked reading comprehension tests based on passages of similar length and linguistic complexity.

Task: Read a passage for comprehension, then select from one of four options the correct answer to questions related to the literal or implied meaning of aspects of the passage. Following standard practice, reference back to the passage was allowed while the questions were being answered.

Source: Ten four-option multiple-choice questions were developed for each of the "St. Nicholas" and "Flies" passages on the Miller-Coleman scale.

22. Test C4. Cloze Reading Comprehension. (Passage equated) (30 items, 15 minutes)

Purpose: To assess performance on a cloze reading comprehension test for purposes of correlating this with performance on multiple-choice and chunked reading comprehension tests based on passages of similar length and linguistic complexity.

Task: Write in the missing words in the blank spaces which have been left in a story. e.g.

Billy________very happy every day. ____________
was Billy's birthday. He____________very, very happy.
His_________________called him and said, "____________,
I have a surprise________you." ....

Source: After a preliminary trial, the "Jimmie Cod" passage from the Miller-Coleman scale was selected as suitable for Grade 6 children. The second word, determined by random choice from the first five words, was deleted and every fifth word thereafter. Credit was given only when the exact word deleted was nominated.

23. Test C5. Chunked Reading Comprehension (Passage equated). (17 items, 12 minutes)

Purpose: To assess performance on a chunked reading comprehension test for purposes of correlating this with performance on multiple-choice and cloze reading comprehension tests based on passages of similar length and linguistic complexity.

Task: Read a story, then on another page select those parts of the reproduced story in chunked form (i.e. one option in each question) which are changed from the original version. Reference back to the original version is not allowed. One passage, for example, began thus:

We were all ready for the trail with our packs strapped on securely. We followed the trail nearly all day.........

The corresponding questions were:

1. (a) We were
   (b) all ready
   (c) for the trail
   (d) with our packs
   (e) safely hidden in bushes
2. (a) We walked in the rain
   (b) nearly all day
   (c) except when
   (d) we stopped to lunch
   (e) by the side

Source: This type of test was proposed by Carver (1970). The two MCRS (Miller-Coleman Readability Scale) passages selected were "Mount Everest" and "Camping". Checks made in developing the test showed that in only four items could the correct answer be selected by children above chance expectation without their having seen the passage. These items could not be eliminated because of the need to maintain the continuity of the passage in the chunked presentation, but they were not credited in the final marking.

24. Test C6. Comprehension of Questions (18 items) (20 minutes for Tests C6 and C7 together)

Purpose: To assess comprehension of simple questions by selecting an appropriate answer to each question from one of four options.

Task: Choose the best answer to the question e.g.

*When did Tom come here?

A. By taxi
B. Yes, he did
C. To study history
D. Last night

---

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Source: Part 1, Sentence Comprehension, from An Experimental Test of English as a Foreign Language (ETS, 1971), with minor wording alterations, and six additional items of a similar kind. The test appeared to provide a measure of pure comprehension involving little if any inference, but depended more on semantic meaning than did the tests of syntactic comprehension. It appeared likely to measure grammatical and syntactical abilities also. The items for this test were mixed with items for Test C7 for administration purposes, the two tests being administered as one test.

25. Test C7. Comprehension of Statements (18 items)

Purpose: To assess comprehension of simple statements.

Task: Read a statement, then select one of four options which gives the best meaning of that statement. e.g.

John dropped the letter in the postbox.

A. John sent the letter.
B. John opened the letter.
C. John lost the letter.
D. John destroyed the letter.

Source: Part 1, Sentence Comprehension from An Experimental Test of English as a Foreign Language (ETS, 1971), with minor wording alterations. Again, the test appeared to provide a measure of pure comprehension, though involving more semantic meaning than the tests of syntactic comprehension. It was administered with Test C6 as one test.

26, 27. Tests C8, C9. Following Printed Instructions A (C8: 8 items)
Following Printed Instructions B (C9: 8 items)
(10 minutes for Tests C8 and C9 together)

Purpose: To assess proficiency in following printed instructions as a further measure of reading comprehension.

Task: Test C8

Write your name with your last name first and then your other names.

Test C9

e.g. Each of the words given has a number above and one below. Write out the word which has a number above it which is different from the numbers above the other words.

8 5 8
COAT MEAT BOOT
6 6 4

Source: Source and construction details are given in Appendix A. From a pool of paired items, eight item types which were done correctly by a very high proportion of children in oral form, written form or both oral and written forms were grouped into one sub-test (Following Printed Instructions A) and treated as a measure of pure or basic reading comprehension. The other eight item types which tended to be worked incorrectly by a substantial proportion of children in oral form, written form or both oral and written forms were grouped into another sub-test (Following Printed Instructions B) and treated as a more complex measure involving a mixture of both reading comprehension and inference.

28, 29. Tests C10, C11. Comprehension of Explicit/Implicit Information (30 Minutes)

C10. Explicit Information (12 items)
C11. Implicit Information (6 items)

Purpose: To assess proficiency via multiple-choice format in comprehending information given explicitly or implicitly in a passage, when incorrect multiple-choice options either contradict or have no relevance to information in the passage.

Task: Read a passage, then answer questions on the passage by selecting one of three options, e.g.

Passage. A woman I met in London has an unusual job. Each day she disguises herself and visits a certain department store pretending to be a customer. Sometimes she has the manner of a duchess, other days she appears to be a poor housewife. Then she reports to the management on how she is treated by the sales clerks.

The woman in London is really:

A. an employee of the store B. a customer of the store
C. an old lady

(Note that the passage contains no information relevant to option C. Option A agrees with, and Option B contradicts implicit information given in the passage. This is an illustrative example only, and did not form part of the actual test.)

Source: Test constructed according to design put forward by Schlesinger and Weiser (1970) to allow for the systematic construction of items for a reading comprehension test. Additional test construction details are included in Appendix A. Insufficient items were available in these tests to provide separate measures based on separate passages.

30. Test C12. Reading to Note Details (12 items, 12 minutes)

Purpose: To assess proficiency in grasping points of detail presented in a passage.

Task: Select one of five alternative answers to a question calling for understanding of detailed information included in a passage.

e.g. Passage. In the Australian bush there is a strange bird called the laughing jackass. Every morning it wakens with its loud laughter people living in the country.

The jackass:

A. crows B. laughs C. brays D. dances E. swims

31. Test C13. Reading for Inference (12 items, 9 minutes)

Purpose: To assess proficiency in inferring subsequent events from information given in a passage.

Task: Read a passage, then select from one of four options what is likely to happen next. e.g.

Betty and her mother went shopping. Betty needed a new dress.

A. They had lunch
B. Betty loved her mother
C. Her mother picked flowers
D. They bought a dress

V. MEASURES OF REASONING

A primary aim of the present study was to determine whether it was possible to distinguish between comprehension tests which draw on inferential abilities and those which do not. Comprehension of printed verbal material would appear to require some reasoning or inference on the part of the reader as the material becomes more complex, even if little or no reasoning is necessary with simple material. Intelligence or reasoning ability would thus seem to be a component of some importance in reading comprehension, quite apart from components arising from the phonological, gramatical and lexical sub-systems of language. It was therefore necessary to include some reference tests of reasoning ability in the battery. Previous studies of comprehension (Clark, 1972, 1973; Spearritt, 1962) included reference tests (French 1951, 1954, French et al., 1963) designed to distinguish between inductive reasoning and deductive reasoning abilities, but this separation does not always emerge and the the tests often tend to coalesce into one broad factor of reasoning ability. The tests chosen to measure reasoning in this study were those which best defined the reasoning factors in the studies of comprehension referred to above and include a non-verbal test which is likely to provide a more adequate assessment of the reasoning abilities of students who have not fully mastered the skills required for decoding printed discourse.

32. Test R1. Letter Grouping (30 items, 4 minutes)

Purpose: To assess proficiency in finding general concepts that will fit sets of data.

Task: Four sets of four letters each are presented. Three of the sets are alike in some way. Select the one that is different. e.g.

XURM ABCD MNOP EFGH

33, 34, 35, 36. Tests R2, R3, R4, R5. Raven's Progressive Matrices, 1938. (20 minutes)
Sets A & B (24 items); Set C (12 items); Set D (12 items); Set E (12 items)

Purpose: To assess proficiency in reasoning with diagrammatic material.

Task: Select from among six or eight figures the one that would fit in the lower right corner of a pattern or matrix which is either symmetrical in form or involves a serial progression in horizontal and/or vertical directions.

Source: Test developed by J.C. Raven 1938 Included as a reference test for Induction in E.T.S. Kit.

37. Test R6. Reasoning (30 items, 5 minutes)

Purpose: To assess proficiency in reasoning from given premises to their necessary conclusion.

Task: After studying the given facts, write the correct word in the conclusion e.g.

M is younger than N.
K is older than N, therefore K is ____________ than M.

Source: Test developed by L.L. Thurstone, 1952.
Included as reference test for Deduction in E.T.S. Kit.

38. Test R7. Verbal Intelligence (71, 75 items)

Purpose: To assess proficiency in reasoning with types of verbal and quantitative questions commonly included in group tests of verbal intelligence.

Task: No special test was administered, as assessed IQ's were available for most children from verbal intelligence tests administered by school counsellors.

Source: Assessed IQ's in general represent an average of IQ's obtained from the Test of Learning Ability TOLA 4, (A.C.E.R.) administered when the children were in Grade 4, and Intermediate D, (A.C.E.R., 1949), administered in Grade 6.

VI. MEASURES OF SPEED OF PROCESSING PRINTED VERBAL MATERIAL

Children are likely to differ not only in their extent of comprehension of printed verbal material, that is, in their power of comprehension, but also in their speed of comprehension of such material. A study of the components of reading comprehension should therefore include measures of comprehension obtained under speeded as well as unspeeded conditions, since additional components may be present under the speeded condition. One such component could be the speed with which children can perceive the actual letters and words in a passage. Tests of the perceptual speed factor were included in the battery to measure this dimension. The effect of speeded conditions on reading comprehension was allowed for by including a speed of reading test, and also by applying under speeded conditions a cloze test of reading comprehension based on a passage of equivalent length and complexity to that used in the cloze reading comprehension test C4 which was administered under unspeeded conditions.

39. Test S1. Speeded Cloze Reading Comprehension (Passage equated) (30 items, 4 minutes)

Purpose: To assess performance on a cloze reading comprehension test under speeded conditions.

Task: As for Test C4, but accompanied by instructions to children to work quickly as they would not be allowed much time for the test.

Source: "Cherokee Indians" passage from the Miller-Coleman Readability scale, of similar length and linguistic complexity to the "Jimmie Cod" passage employed in the unspeeded cloze test.

40. Test S2. Chapman-Cook Speed of Reading Test (30 items, 2½ minutes)

Purpose: To assess speed of comprehending simple verbal material

Task: Cross out, in the second part of each paragraph, the one word which spoils the meaning. e.g.

> There was a fire last night, and five houses were burned to the ground. It all happened because someone was careless, and threw a nail into the waste-paper basket.

41. Test S3. First Digit Cancellation (75 items, 3 minutes)

Purpose: To assess speed of locating a well-known numerical symbol in a mass of material.

Task: Cross out each number in a row that is like the circled number at the beginning of that row.

⑧ 7 6 0 3 5 2 1 0 . . . . 1 8

Source: L.L. Thurstone. Included as a reference test for Speed of Symbol Discrimination or Perceptual Speed factor in E.T.S. Kit. (French, 1954).

42. Test S4. Letter "A" (200 items, 2½ minutes)

Purpose: To assess speed of locating a well-known verbal symbol in a mass of material.

Task: Each column of words has four words containing the letter "a". Find these four words in each column as quickly as possible.

Source: L.L. Thurstone. Included as a reference test for Speed of Symbol Discrimination or Perceptual Speed factor in E.T.S. Kit. (French, 1954, French et al., 1963).

C. SELECTION OF SAMPLE

Three large government schools were selected from each of two contrasting socio-economic groupings in metropolitan Sydney and all sixth grade children in these schools were included in the sample. Congalton's seven-point scale (1969), which was based on ratings of the social standing of Sydney suburbs by samples of Sydney residents and of real estate agents, was used to provide an estimate of the socio-economic rating of areas. Children from areas in Categories 2 and 3 of Congalton's scale were regarded as falling within the middle-class socio-economic grouping and children from areas in Categories 5 and 6 of the scale as falling within the lower-class socio-economic grouping. These socio-economic classifications were subsequently found to be valid for the areas concerned by reference to a more recent and objectively based analysis of socio-economic status in different parts of Sydney (Davis and Spearritt, 1974), except for one of the schools whose catchment area was not as distinctively lower-class in character as had formerly been assumed.

Permission to seek the cooperation of the schools was granted by the Director-General of Education in New South Wales. Schools were selected for the study only if 90% or more of their Grade 6 children were native speakers of English and if their Grade 6 classes were not involved in other experimental work. The three schools within each socio-economic group were widely dispersed geographically.

Table 3.2 shows the number of children tested in each school at any time and the number of children included in the final sample for data analysis. Children for whom complete or almost complete results were not available were excluded from the final sample. The mean score of the child's class was assigned to a child in the ten instances in which between one and four of the scores were not available for that child.

Table 3.2. Details of Sample

		Number tested at any time			Number included in final sample		
		Boys	Girls	Total	Boys	Girls	Total
Middle-Class Areas							
School A		83	90	173	70	71	141
School B		95	78	173	81	63	144
School C		21	43	64	15	39	54
	Total	199	211	410	166	173	339
Lower-Class Areas							
School D		79	75	154	55	40	95
School E		61	53	114	50	40	90
School F		70	68	138	50	50	100
	Total	210	196	406	155	130	285

D. APPLICATION OF TEST BATTERY

Since approximately 10 hours were required for the administration of the battery of 38 tests, the testing program was spread over four mornings. Most of the reading comprehension tests were applied during the first 90-minute testing session each morning, the remaining tests being applied in the latter part of this session or in the 60-minute testing session following the mid-morning recess. In determining the day and the order in which the tests were administered, account was taken of the need to provide pupils with a variety of tests in any one day. The order of administration is set out in Appendix B.

The tests were administered by seven experienced testers - school counsellors or teachers or research assistants - over a five-week period from 5th November to 10th December, 1973. While it was planned to have a time lapse of one week between each of the four test administrations within a school, it was not always possible to arrange this within the school's time table. Although the number of days between the application of successive administrations ranged mostly between five and nine, there were five instances in which there was an interval of three days or less between successive administrations of two sections of the test battery. Since a time lapse of one week between test administrations was sought largely for the convenience of school organisation, and since there were no observed fatigue or reduced motivational effects in the latter cases, this variation in the testing time pattern does not seem likely to have influenced the pattern of test results.

Except for a couple of instances, the pencil and paper tests were applied by each tester to the same class on each of the four mornings. All classes within a school were tested at the same time, each tester following standard instructions for gaining pupils' interest in the program and for administration of the tests. The only variation in the order of testing occurred with the two tests presented by tape-recorder, which were applied at different times on the third day by two of the testers only.

Data relating to the children's performance on relevant achievement and verbal intelligence tests were obtained from school records.

E. SCORING OF TESTS

In most of the tests, there was only one correct answer for each question, and one mark was credited for this answer. In the case of tests requiring a constructed response of more than one word, (i.e. G5 Scrambled Sentences, G7 Comprehension of Sentence Structures, G8 Comprehension of Anaphoric Expressions, and G9 Embedded Sentences), answers were marked against a scoring key listing all acceptable responses. For the cloze tests, credit was given for the insertion of the exact word only. In the Ambiguous Sentences test, credit was given for an item only if the correct two from the four line drawings for each item were identified.

F. RELIABILITY COEFFICIENTS OF TESTS

Reliability coefficients were computed for most of the tests to indicate the extent to which they were providing consistent or stable measures of the skill in question. The coefficients, which are set out in Appendix C, were of a sufficiently high level for a factor analytic study, except in the case of Test C11, Comprehension of Implicit Information, which contained only six items. As a result, less reliance has been placed on factor loadings derived for this test.

CHAPTER IV

RESULTS OF EXPERIMENTAL STUDY

The results of the main factor analytic study are presented in this chapter, together with the results of a number of subsidiary analyses based either on the complete final sample of 624 cases or a one-in-six systematic random sample of 104 cases drawn from the final sample. The correlation matrices on which the main factor analytic study is based are given in abridged form (i.e. correct to two decimal places) in Appendices D.1 and D.2. They were derived from normalized nine-point scales in most instances so that disparate raw score distributions would not distort the factor structure. In the case of tests with highly skewed raw score distributions, seven point or five-point normalized score scales were used (for 6 tests) or normalized T score scales with a mean of 50 and an S.D. of 10 were employed (for 7 tests). Correlations of the test with age were mostly between 0.00 and -.20 for middle class groups, and between 0.00 and -.30 for lower class groups.

A. RESULTS OF FACTOR ANALYTIC STUDY

Separate factor analyses of 42-variable correlation matrices were undertaken for each of the four socio-economic class X sex groupings i.e. middle class boys, middle class girls, lower class boys and lower class girls. Two forms of factor analysis were applied to each of the four correlation matrices (Appendices D.1 and D.2). In determining the number of factors, reliance was placed on the unrestricted maximum likelihood method (Jöreskog and van Thillo, 1971), which allowed the use of a statistical test of goodness of fit to determine the minimum number of factors required to account for the observed correlations. Principal factor solutions using squared multiple correlations as communality estimates were also obtained for the number of factors corresponding to the number of eigenvalues greater than unity, and for the number of factors designated as significant by the maximum likelihood method.

Normal varimax rotations of the factors obtained by each method provided orthogonal solutions (i.e. with uncorrelated factors) for comparison with the factor pattern hypothesized in Table 3.1 in Chapter 3.

The number of factors needed to account for the correlations in each of the four class-sex groupings, as indicated by the unrestricted maximum likelihood method, is set out in Table 4.1. For purposes of comparison, the last column in the table shows the number of eigenvalues greater than unity in the principal factor solutions.

Table 4.1 Number of significant factors for class-sex groupings with associated indices

Group	N	No. of factors	χ^2	df	p	Tucker's reliability coefficient	No. of eigen-values >1
Middle class boys	166	6	665.86	624	.12	.982	9
Middle class girls	173	8	595.97	553	.10	.980	8
Lower class boys	155	7	620.83	588	.17	.989	5
Lower class girls	130	6	660.60	624	.15	.983	7

The rotated maximum likelihood factor solutions corresponding to the number of factors indicated for each class-sex grouping are included in Appendices E.1 to E.4. Principal factor solutions are not presented since they yielded the same factors and similar factor loadings to the maximum likelihood solutions in most cases. Additional factors designated as significant by the principal factor solutions were in most instances defined by one test only or based on moderate to low loadings on a small number of variables with no discernible pattern linking the variables. Since the factors for each of the four class-sex groupings correspond to a large extent, the solutions have been brought together for the purpose of factor interpretation. To simplify the presentation, the tables of factor loadings in the following pages consist of varimax rotated maximum likelihood factors only, except where rotated principal factor loadings are needed to clarify the interpretation of the factor.

Factors are defined below largely in terms of those tests with loadings $\geq .30$ on the factor, as loadings of this magnitude are significantly different ($p < .001$) from zero. The tests represented in the factor are listed in each case, in order of the size of their loadings on the factor to the extent possible. Where loadings fell below .30 for one or two class-sex groups, the actual loadings have been included in brackets.

Factor A - Knowledge of Word Meanings

The order of listing of tests in Factor A is based on an average rank order of the loadings of the tests within each class-sex group. In respect of the tests defining Factor A (i.e. with loadings ⩾.30), there was almost perfect agreement between the rotated maximum-likelihood and principal factor solutions for the four class-sex groups.

Table 4.2. Factor A

	Factor loadings			
Test	Middle Class Boys (Factor V)	Middle Class Girls (Factor III)	Lower Class Boys (Factor II)	Lower Class Girls (Factor IV)
L1. Vocab, no context	.53	.69	.64	.72
G8. Anaphora	.44	.54	.74	.48
C1. Basic Skills, Literal Mng.	.47	.53	.72	.44
G10. Deep Structure	.40	.45	.74	.58
G2. Linguistic Markers	.63	.52	.65	.48
R7. Verbal Intelligence	.47	.52	.60	.59
L3. Vocab. in context	.40	.65	.65	.48
S1. Speeded Cloze Rdg. Comp.	.43	.52	.68	.50
G5. Scrambled Sentences	.50	.40	.68	.52
C7. Comprehension Statements	(.20)	.55	.82	.53
S2. C-C Spd. Rdg.	.43	.62	.62	.50
P1. Word Sounds	.49	.42	.59	.67
C5. Chunked Rdg. Comp.	.31	.50	.66	.61
P2. Finding Rhymes	.50	.38	.55	.72
C4. Cloze Rdg. Comp.	.30	.49	.64	.69
C13. Rdg. for Inference	(.29)	.63	.68	.47
C2. Basic Skills, Implied Mng.	.37	.73	.56	.41
C10. Explicit Inf. Rdg. Comp.	(.22)	.66	.70	(.24)
C3. Mult. Choice Rdg. Comp.	.30	.47	.64	.51
C12. Rdg. Note Details	.40	.53	.56	.37
G9. Embedded Sentences	.56	.34	.63	.38
G3. Punctuation A	.38	(.28)	.54	.64
G6. Combining Sentences	.35	.47	.65	.32
P3. Hidden Words	(.24)	.40	.45	.59
G1. Word Uses	.37	(.28)	.48	.55
C6. Comprehension Questions	(.24)	.34	.71	.32
L2. English Picture Vocab.	(.17)	.55	.42	.43
G7. Compreh. of Sent. Struct.	(.23)	.49	.53	.42
G4. Punctuation B	(.16)	(.28)	.53	.57
C9. Following Inst. B	(.18)	(.29)	.52	.52
C11. Implicit Inf. Rdg. Comp.	(.16)	.52	.54	(.23)
P4. Word Attack	.34	.38	.39	.37
C8. Following Inst. A.	.33	(.02)	.37	.48
R6. Thurstone Reasoning	-	.44	-	-

The tests which do not have significant loadings on Factor A are almost as important in arriving at an interpretation of the factor as those that do. In particular, the non-verbal sub-tests of Progressive Matrices 1938, the Letter Grouping Test of meaningless groups of letters and the Perceptual Speed tests are not represented in the factor. With two partial exceptions, viz. Thurstone Reasoning and Ambiguous Sentences, any test involving the association of a printed word symbol with its spoken form (e.g. Word Sounds) or with the meaning of the word is represented in the factor. The inclusion of the Word Sounds test in the list would suggest that the factor might involve no more than making the connection between the printed word symbol and the corresponding spoken form. But all of the other tests in the list, including vocabulary tests with quite high loadings, call for the association of a printed or spoken word symbol with its meaning. The factor has therefore been labelled as knowledge of word meanings. It conforms closely with the hypothesized factors of vocabulary knowledge and phonological-orthographical competence as outlined in Table 3.1; the suggested distinction between these two factors was not confirmed by the data. It would appear that at the Grade 6 level the skill of associating a printed word symbol with its corresponding spoken form is generally well established so that differences among children's performance in this respect are overshadowed by differences in their ability to extract the meaning of words from the printed word symbols perceived by them.

Factor B - Reasoning

Factor B groups together those tests which appear to define a similar factor in all four rotated maximum-likelihood solutions. The corresponding rotated principal factor solutions conformed closely with those presented in Table 4.3, and helped to define the factor more sharply in that many of the loadings in the range from .30 to .35 in the table fell below .30 in the principal factor solutions.

Table 4.3 Factor B

	Factor loadings			
	Middle Class Boys (Factor IV)	Middle Class Girls (Factor II)	Lower Class Boys (Factor III)	Lower Class Girls (Factor II)
R2. Prog. Matrices 38, A+B	.50	.54	.67	.50
R3. Prog. Matrices 38, C	.49	.44	.65	.65
R4. Prog. Matrices 38, D	.57	.76	.74	.80
R5. Prog. Matrices 38, E	.62	.37	.50	.50
C9. Following Inst. B	.37	.44	.33	.31
R7. Verbal Intelligence	.32	.43	.34	(.26)
G6. Combining Sentences	-	.52	-	-
C1. Basic Skills, Literal Mng.	-	.44	-	-
G10. Deep Structure	-	.40	.31	-
C5. Chunked Rdg. Comp.	-	.38	-	-
G5. Scrambled Sentences	-	.35	.35	.33
G2. Linguistic Markers	-	.33	-	-
C10. Explicit Inf. Rdg. Comp.	-	.33	-	-
C8. Following Inst. A	-	.33	-	.32
L2. English Picture Vocab.	-	.32	.32	-
C3. Mult. Choice Rdg. Comp.	-	.32	-	-
C11. Implicit Inf. Rdg. Comp.	-	.31	-	-
G3. Punctuation A	-	-	.37	-
L3. Vocab. in context	-	-	.32	-
L1. Vocab. no context	-	-	.31	-

Being largely defined in these solutions by the sub-tests of Progressive Matrices, 1938, this factor is clearly a reasoning factor, of the form hypothesised in Table 3.1. The loadings of the verbal intelligence rating obtained within the school and the loadings of the Following Instructions B test, requiring the following of more complex directions are consistent with this interpretation. The solutions presented suggest that the factor is largely determined by the diagrammatic form of reasoning item employed in the Progressive Matrices test. However, subsequent comparisons of factor solutions* based on correlation matrices using the sub-scores of the Progressive Matrices test, and then the total score instead of the sub-scores, showed that the factor was not chiefly determined by diagrammatic items but that it was defined by Following Instructions B, Verbal Intelligence and to a lesser extent, Following Instructions A and Deep Structure, as well as by Progressive Matrices 1938 total score. Nevertheless, the factor is not as widely based a reasoning factor as hypothesized. Probably because of the importance attached to speed of working, the Letter Grouping and Thurstone Reasoning tests, included as reference tests for inductive and deductive reasoning factors respectively, were found to be represented on a speed factor rather than on a reasoning factor.

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* These comprised eight-factor rotated maximum likelihood and principal factor solutions for all boys and for all girls.

In the interpretation of the present factor, not much store need be placed on the tests listed in the lowest part of Table 4.3. With one or two exceptions, the loadings for these tests are not substantial, reaching significance in only one or two of the four maximum likelihood solutions and often failing to reach significance in the corresponding principal factor solutions. Some of the tests are reading comprehension tests, which were hypothesized to have significant loadings on a reasoning factor, but many of the tests in the lowest part of the table were not expected to be significantly loaded on such a factor.

Factor C - Semantic Context

Factor C is clearly defined by a common set of tests for maximum-likelihood solutions for Middle Class Boys, Lower Class Boys and Lower Class Girls, and for the principal factor but not the maximum-likelihood solution for Middle Class Girls.* For middle class boys and the lower class groups, the rotated principal factor solutions conformed closely with the maximum-likelihood solutions with regard to the tests with loadings of ≥.30 on Factor C.

Table 4.4 Factor C

		Factor loadings			
	Test	Middle Class Boys (Factor I)	Middle Class Girls (Factor PF)**	Lower Class Boys (Factor PF)≠	Lower Class Girls (Factor I)
C10.	Explicit Inf., Rdg. Comp.	.72	.58	.55	.69
C1.	Basic Skills, Lit. Mng.	.54	.54	.53	.68
C11.	Implicit Inf., Rdg. Comp.	.63	.34	.58	.58
C7.	Comprehension Statements	.53	.49	.64	.45
C2.	Basic Skills, Imp. Mng.	.57	.58	.31	.62
G6.	Combining Sentences	.36	.58	.52	.59
C5.	Chunked Rdg. Comp.	.41	.49	.55	.46
C3.	Mult. Choice Rdg. Comp.	.44	.50	.46	.48
C12.	Rdg. Note Details	.58	.35	(.29)	.48
C13.	Rdg. for Inference	.61	.57	.47	.39
G10.	Deep Structure	.33	.33	.51	.50
L1.	Vocab, no context	.45	.40	.38	.40
G5.	Scrambled Sentences	.33	.36	.43	.49
L3.	Vocab. in context	.34	.36	.42	.44
G2.	Linguistic Markers	.33	.44	.33	.45
P1.	Word Sounds	(.21)	.51	.52	.30
G8.	Anaphora	.36	.41	.36	.40
C6.	Comprehension Questions	.30	.45	.52	(.23)
L2.	English Picture Vocab.	.41	(.27)	(.22)	.49
R7.	Verbal Intelligence	.38	(.28)	.32	.36
S2.	C-C Spd. Rdg.	.32	.31	.32	.38
S1.	Speeded Close Rdg. Comp.	.39	(.22)	.37	.32
G9.	Embedded Sentences	-	.30	-	.53
C9.	Following Inst. B.	(.28)	.33	.47	(.18)
G7.	Compreh. of Sent. Struct.	.32	-	.32	-
R4.	Prog. Matrices 38, D	-	.37	-	-
P4.	Word Attack	-	-	.46	-
P2.	Finding Rhymes	-	-	.40	-
C4.	Close Rdg. Comp.	(.21)	(.22)	.35	(.25)
C8.	Following Inst. A	(.25)	(.18)	.32	(.23)

* In some cases, principal factor solutions provided a clearer interpretation of a factor than the maximum likelihood solutions because of the differing methods of factor extraction and the differing criteria for acceptance of factors as significant.

** A varimax-rotated principal factor.

≠ A varimax-rotated principal factor. A very similar factor was identified in an eight-factor maximum likelihood solution for lower class boys.

The loading for the underlined tests in Factor C indicate that the factor is best defined by the reading comprehension tests, all of which are represented in three or more solutions excepting the tests requiring the following of printed instructions (A and B) and the cloze test, which are represented in only one or two solutions. The factor corresponds closely with the hypothesized factor of "Syntactic Comprehension" in Table 3.1, differing mainly in relation to the absence of significant loadings for the tests of punctuation and reasoning (R6) and to the presence of significant though not substantial loadings for the vocabulary tests. The relatively low loadings for the measures of syntactic comprehension (i.e. Comprehension of Sentence Structure, Anaphora, Embedded Sentences, Deep Structure and Ambiguous Sentences), coupled with the higher loadings for the tests of reading comprehension, suggest that the factor represents the apprehension of the explicit and implicit meaning of sentences and passages rather than a mere literal translation of the basic information contained in a sentence. Because of its involvement with the meaning of sentences and passages in their wider context, the factor appears to be a semantic context factor rather than 'syntactic comprehension'. The unspeeded cloze test is the only regular reading comprehension test which fails to conform with this interpretation. The factor could also be described as a reading comprehension factor or as the well-established verbal comprehension factor, but these labels are not sufficiently specific to describe its nature fully.

Factor D - Sentence Comprehension

A factor with common patterns of loadings in the solutions for Middle Class Boys, Middle Class Girls and, to a lesser extent, Lower Class Girls forms the basis of the grouping set out under Factor D. For the two middle class groups, principal factor loadings identified the same factors as the maximum likelihood loadings, though somewhat less strongly. For Lower Class Girls, the factor could be identified in the principal factor solution only. No corresponding factor emerged for Lower Class Boys in either the maximum likelihood or principal factor solution, the variance of the relevant tests having been absorbed by the reasoning factor, knowledge of word meanings and semantic context factor.

Table 4.5 Factor D

	Factor loadings		
Test	Middle Class Boys (Factor VI)	Middle Class Girls (Factor VI)	Lower Class Girls (Factor PF)*
C6. Comprehension Questions	.61	.64	.41
C7. Comprehension Statements	.66	.33	(.22)
C8. Following Inst. A	.37	.37	(.14)
C9. Following Inst. B	.40	.31	.33
C13. Rdg. for Inference	.40	.39	(.19)
G6. Combining Sentences	.52	-	-
G10. Deep Structure	.43	-	-
G2. Linguistic Markers	.40	-	-
C4. Close Rdg. Comp.	.37	-	-
C3. Mult.-Choice Rdg. Comp.	.34	-	-
C5. Chunked Rdg. Comp.	.34	-	-
C2. Basic Skills, Implied Mng.	.32	-	.30
L3. Vocab. in context	.32	-	-
C12. Rdg. Note Details	-	-	.38
G11. Ambiguous Sentences	-	-	.35
R5. Prog. Matrices 38, E	-	-	.32

* A varimax-rotated principal factor

Factor D is defined chiefly by Comprehension of Questions and less strongly by Comprehension of Statements, the two types of item incorporated in the Sentence Comprehension sub-test of An Experimental Test of English as a Foreign Language (ETS, 1971); it is also defined by the two tests designed to assess proficiency in following printed instructions. The characteristic of these tests which distinguishes them from other tests of reading comprehension is that they are based on the comprehension of sentences, not passages. With the exception of Following Instructions B, which was thought to require some reasoning on the part of the student, the tests were expected to measure pure comprehension involving appreciation of semantic meaning but not inference. The factor can be appropriately interpreted as sentence comprehension, and probably represents a simpler level of comprehension in a limited context than that involved in understanding the passage-type comprehension tests which define the semantic context factor, Factor C. The loadings for the Reading for Inference test are not consistent with this interpretation of Factor D, though it is relevant to note that the passages used in this test are considerably shorter than in the other reading comprehension tests, comprising three sentences or less in many of the items.

The hypothesized factors did not include a sentence comprehension factor of the type represented by Factor D.

Factor E - Punctuation

Corresponding factors from the rotated maximum likelihood solutions for Middle Class Boys, Middle Class Girls, and Lower Class Boys and for the rotated principal factor solution for Lower Class Girls are grouped under Factor E. The two types of solution produced very similar patterns of significant loadings on Factor E for the two middle class groups, and for seven-factor solutions, for Lower Class Girls also. This similarity, however, did not extend to Lower Class Boys, Factor E being identified only by the maximum likelihood solution.

Table 4.6 Factor E

Test		Factor loadings			
		Middle Class Boys (Factor II)	Middle Class Girls (Factor IV)	Lower Class Boys (Factor I)	Lower Class Girls (Factor PF)*
G4.	Punctuation B	.83	.74	.74	.54
G3.	Punctuation A	.64	.75	.47	.53
P2.	Finding Rhymes	.30	.50	-	-
S1.	Speeded Cloze Rdg. Comp.	.34	-	-	-
G10.	Deep Structure	-	.40	-	-
R7.	Verbal Intelligence	-	.38	-	-
G5.	Scrambled Sentences	-	.38	-	-
G8.	Anaphora	-	.35	-	-
P1.	Word Sounds	-	.33	-	-
C9.	Following Inst. B	-	-	-	.44
C5.	Chunked Rdg. Comp.	-	-	-	.33
S4.	Letter A	-	-	-	.32

* A varimax-rotated principal factor.

The substantial loadings of the punctuation tests on Factor E justify its interpretation as a punctuation factor, representing the children's degree of proficiency in supplying appropriate punctuation marks for unpunctuated passages. For the middle class groupings, the factor is not fully differentiated from tests involving sound-symbol identification. The tests listed in the lowest part of Table 4.5 have significant representation on the factor in only one of the class-sex groups, and thus do not detract from the interpretation given to the factor.

The Punctuation factor corresponded closely to the hypothesized factor of the same name. The hypothesized loadings on this factor for the cloze reading comprehension tests did not eventuate, except for the speeded form of the cloze test in the solution for Middle Class Boys. There is thus no support for the idea that reading comprehension tests of the cloze type make more use of punctuation clues than other forms of reading comprehension test.

Factor F - Perceptual Speed

Factor F groups together another factor from each of the four class-sex groups with a similar pattern of factor loadings. The pattern of loadings produced for each group was also similar for both the rotated maximum likelihood and principal factor solutions, although the latter type of solution tended to define the factor more sharply.

Table 4.7 Factor F

		Factor loadings			
	Test	Middle Class Boys (Factor III)	Middle Class Girls (Factor V)	Lower Class Boys (Factor IV)	Lower Class Girls (Factor III)
S3.	First Digit Cancellation	.53	.71	.68	.53
S4.	Letter A	.37	.59	.46	.50
R1.	Letter Grouping	.55	.30	.55	.47
P3.	Hidden Words	.53	(.20)	.44	.31
S1.	Speeded Cloze Rdg. Comp.	.37	.34	(.16)	.32
R6.	Thurstone Reasoning	.55	-	.42	-
S2.	C-C Spd. Rdg.	.44	-	.36	-
G10.	Deep Structure	.41	-	-	.33
L3.	Vocab. in Context	.33	-	-	.38
C9.	Following Inst. B	.33	-	-	.45
R7.	Verbal Intelligence	.33	-	-	.31
G2.	Linguistic Markers	-	-	.31	.46
C5.	Chunked Rdg. Comp.	.38	-	-	-
L1.	Vocab., no context	.34	-	-	-
G4.	Punctuation B	-	-	-	.53
G3.	Punctuation A	-	-	-	.52
G8.	Anaphora	-	-	-	.36
G9.	Embedded Sentences	-	-	-	.33
C7.	Compreh. of Sent. Struct.	-	-	-	.31
R5.	Prog. Matrices 38, E	-	-	.35	-

The tests of First Digit Cancellation and Letter "A", (see page 46) were included in the battery as reference tests for the Perceptual Speed factor, and as they have substantial loadings on Factor F in both types of solutions for all four class-sex groups, the factor is appropriately identified as a Perceptual Speed factor. Table 4.7 reveals that Letter Grouping, Thurstone Reasoning and Hidden Words have substantial loadings on this factor but in the case of the latter two tests, the loadings obtained from the principal factor solution tend to be considerably lower. The representation of the three tests on this factor was unexpected, as Letter Grouping and Thurstone Reasoning are reference tests for the inductive and deductive reasoning factors respectively, and Hidden Words was included as a measure of phonological-orthographical competence. In working through the tests, however, a child who was able to locate verbal symbols quickly would have an advantage over perceptually slower children, so that the loadings of these tests on the Perceptual Speed factor are understandable, as are also the loadings of the other speeded tests viz. Speeded Cloze Reading Comprehension and Chapman-Cook Speed of Reading. The loadings presented for other tests in Table 4.7 tend to be smaller or confined to one solution only and in the case of the principal factor solutions they were generally below the designated level of significance.

The Perceptual Speed factor was identified in the hypothesized form for the appropriate reference tests, but it attracted variance from a number of other tests also, and this had not been hypothesized.

Ungrouped Factors

Most of the remaining factors with significant loadings in either the maximum likelihood or principal factor solutions were virtually singlet factors specific to individual tests such as Ambiguous Sentences, Hidden Words or Thurstone Reasoning, and they provide no information about what these tests measure in common with other tests in the battery. Other ungrouped factors with significant loadings are set out in Table 4.8; the symbols PF9 refer to a nine-factor principal factor solution, ML8 to an eight-factor maximum-likelihood solution, and so on.

Table 4.8 Ungrouped Factors

Test	Loadings	Test	Loadings
Middle Class Boys			
	PF9		PF9
L2. English Picture Vocab. Test	.57	C6. Compreh. Questions	.44
R6. Thurstone Reasoning	.35	C7. Compreh. Statements	.39
L3. Vocab. in context	.33	C13. Rdg. for Inference	.39
S1. Speeded Cloze Rdg. Comp.	.30	G11. Ambiguous Sentences	.38
	PF9	G6. Combining Sentences	.31
		C4. Cloze Rdg. Comp.	.31
R2. Prog. Matrices, A+B	.42		
C4. Cloze Rdg. Comp.	.39		
Middle Class Girls			
	ML8		PF8
G9. Embedded Sentences	.48	G7. Compreh. of Sent. Struct.	.55
S1. Speeded Cloze Rdg. Comp.	.43	L1. Vocab. no context	.32
C4. Cloze Rdg. Comp.	.41	L3. Vocab. in context	.32
C9. Following Inst. B	.37	P4. Word Attack	.31
		R6. Thurstone Reasoning	.31
Lower Class Boys			
	ML7		PF8
P1. Word Sounds	.37	G11. Ambiguous Sentences	.44
R7. Verbal Intelligence	.36	L2. English Picture Vocab. Test	.39
G1. Word Uses	.33	C11. Implicit Inf. Rdg. Comp.	.34
		R7. Verbal Intelligence	.34
		L1. Vocab., no context	.33
		C12. Rdg. Note Details	.33
Lower Class Girls			
	ML6		ML7
S1. Speeded Cloze Rdg. Comp.	.49	S1. Speeded Cloze Rdg. Comp.	.60
C13. Rdg. for Inference	.36	S2. C-C Spd. Rdg	.54
S2. C-C Spd. Rdg.	.31	L3. Vocab. in context	.47
	ML6	G8. Anaphora	.47
		C13. Rdg. for Inference	.45
R6. Thurstone Reasoning	.45	C4. Cloze Rdg. Comp.	.43
C4. Cloze Rdg. Comp.	.33	G7. Compreh. of Sent. Struct.	.41
		P1. Word Sounds	.39
		P3. Hidden Words	.37

Although all of the factor loadings in Table 4.8 are significant, they are low in magnitude and contribute little to clear factor definition. Many of the factors are, in effect, defined by one test with a distinctly higher loading than the other tests. There is, however, a suggestion of a 'speed of reading' factor for lower class girls and of a possible 'syntactic comprehension' factor involving cloze type tests among middle class girls.

Factors identified for combined group of boys and of girls

Subsidiary analyses were undertaken to determine whether any additional factors would emerge for the combined group of boys (N=321) or for the combined group of girls (N=303). Eight-factor maximum likelihood and principal factor solutions using in turn Progressive Matrices sub-scores and total score produced five factors corresponding to those identified in the preceding pages viz. Knowledge of Word Meanings, Punctuation, Perceptual Speed, Semantic Context and Reasoning though they were less sharply defined for the latter two factors in some solutions. Factor D, Sentence Comprehension was identified in a similar form for boys but only in one of the solutions for girls.

One additional factor emerged in the four solutions for the combined girls' group, with the following loadings.

	Factor loadings			
	With PM38 sub-scores		With PM38 total score	
	ML	PF	ML	PF
R6. Thurstone Reasoning	.36	.48	.46	.54
R1. Letter Grouping	-	.38	.32	.41
L2. English Picture Vocab. Test	.49	.31	.41	.33
R7. Verbal Intelligence	-	-	.35	.34

This appears to be an additional reasoning factor, with a probable emphasis on deductive reasoning, since it is best defined by the reference test R6, Thurstone Reasoning. Such an interpretation must be tentative, however, since the Letter Grouping test is a reference test for inductive reasoning and since the English Picture Vocabulary Test appears to call for little more than the matching of a spoken word with a corresponding picture.

All of the other factors appearing in the solutions for the combined groups of boys or girls were, in effect, singlet factors for which interpretations are not justified.

Data for the combined groups of boys and girls were also used to determine whether the same factors would be identified if differences in reasoning ability were controlled. Maximum likelihood solutions for correlation matrices in which the effect of PM38 total score (non-verbal reasoning) had been partialled out showed that the same factors emerged with the exception of course of the Reasoning factor.

Comparison of hypothesized and identified factors

The outcome for each of the hypothesized factors is summarized in this section.

Hypothesized factor	Identified factor
I. Phonological-orthographical competence	Not identified.
II. Knowledge of grammatical functions.	Not identified.
III. Punctuation.	Punctuation (Factor E).
IV. Syntactic Comprehension.	Not identified as such, but incorporated within a wider factor identified as Semantic Context. (Factor C)
V. Vocabulary Knowledge	Knowledge of Word Meanings. (Factor A)
VI. Reasoning	Reasoning (Factor B), though less widely represented in the reading comprehension tests than hypothesized.
VII. Reading Speed	Not identified, mostly merging with Perceptual Speed factor.
VIII. Perceptual Speed	Perceptual Speed (Factor F).
(IX) No relevant factor hypothesized.	Sentence Comprehension. (Factor D).

The chief difference between hypothesized factors I and V was that the tests of Word Sounds and Finding Rhymes would have significant loadings on the phonological-orthographical competence factor, but not on the vocabulary factor. This distinction was not maintained, and one factor - Knowledge of Word Meanings - proved to be sufficient to account for the hypothesized loadings on the two factors.

The hypothesized factor of knowledge of grammatical functions was expected to be well represented by tests requiring an understanding of the functions performed by particular classes of words in sentences and by cloze tests of reading comprehension. Other tests of knowledge of syntactical structure were also hypothesized to be represented in this factor. The factor, however, did not emerge in the empirical analysis, the variance of the relevant tests being accounted for largely by the factors of knowledge of word meanings and semantic context, and in some cases by reasoning, sentence comprehension, punctuation and perceptual speed factors.

The same tests of grammatical and syntactic competence were also hypothesized to involve a syntactic comprehension factor, but in the empirical analysis the factor in question was found to have much higher loadings on the reading comprehension tests than on the more pure syntactic tests, and was accordingly identified as a semantic context or reading comprehension factor. The results suggest that syntax and content are inextricably interwoven in children's comprehension, and that the prospects for developing separate measures of the syntactic understanding a child brings to his comprehension are not promising.

B. WHAT SKILLS ARE BEING MEASURED BY DIFFERENT TYPES OF READING COMPREHENSION TEST?

Until the 1950's, tests of reading comprehension were predominantly of the multiple-choice type. The advent of the cloze test in 1953 (Taylor, 1953) provided a significant alternative method for measuring reading comprehension, though it took some ten to fifteen years for its potentialities to be fully appreciated. Other forms of reading comprehension test appeared in the early 1970's, largely as an outcome of a renewed interest in the measurement of language comprehension and reading comprehension in particular; these included Carver's "chunked" test (Carver, 1970), and Schlesinger and Weiser's systematically constructed tests of information given explicitly or implicitly in a passage (Schlesinger and Weiser, 1970). Questions were raised about what was being measured by these different types of tests, some tests being thought to depend more heavily on some skills (e.g. syntactic skills) than other tests (Carroll, 1971b). One of the purposes of the present study was to provide information about these issues. In particular, it sought to answer the question: "What skills are being measured by different types of reading comprehension test?"

The hypothesized factor composition of the thirteen tests of reading comprehension and of the two speeded tests of reading were indicated in Table 3.1. It can be seen that all thirteen tests of reading comprehension were expected to have substantial loadings on factors of phonological-orthographical competence, syntactic comprehension and vocabulary knowledge, except that the tests of following printed instructions were hypothesized to have lower loadings on a vocabulary factor because of the relatively simple words used in these tests. All of the tests were expected to have significant loadings on a reasoning factor, except Comprehension of Statements which required the selection of a sentence which was a paraphrase of a stimulus sentence and Following Printed Instructions A which called for the understanding of very simple sentences. Loadings on the reasoning factor, however, were hypothesized to be rather more substantial for tests involving inference than for tests for literal meaning only (e.g. C2 vs. C1, C11 vs. C10, C13 vs. C12), and more substantial for the multiple-choice reading comprehension test than for the cloze and chunked reading tests developed from linguistically equated passages. In addition, the cloze test was singled out as having significant loadings on a grammatical and punctuation factor. Hypothesized loadings for the speeded cloze test paralleled those for the cloze test, but included a reading speed component, which was also expected to appear for the Chapman-Cook Speed of Reading test.

The actual factor composition of the reading comprehension tests is summarized in Table 4.9 in a form convenient for interpretation. The table is based on the factors identified in the earlier section of this chapter and the significant loadings of tests on those factors. Two crosses are used in the table to represent the more substantial factor loadings of .40 and above, with loadings from .30 to .39 being represented by one cross.

Table 4.9. Summary Pattern of Factor Composition of Reading Comprehension Tests

TESTS*	FACTORS Knowledge of Word Meanings	 Semantic Context	 Sentence Comprehension	 Reason-ing	 Percept. Speed	 Punctu-ation
C1. Basic Skills, Literal Meaning	xx xx xx xx	xx xx xx xx		xx		
C2. Basic Skills, Implied Meaning	x xx xx xx	xx xx x xx	x x			
C3. Multiple Choice Rdg. Comp.	x xx xx xx	xx xx xx xx	x	x		
C4. Close Rdg. Comp.	x xx xx xx	x	x			
C5. Chunked Rdg. Comp.	x xx xx xx	xx xx xx xx	x	x	x	x
C6. Comprehension Questions	x xx x	x xx xx	xx xx xx			
C7. Comprehension Statements	xx xx xx	xx xx xx xx	xx x			
C8. Following Instructions A	x x xx	x	x x	x x		
C9. Following Instructions B	xx xx	x xx	xx x x	x xx x x	x xx	xx
C10. Explicit Inf. Rdg. Comp.	xx xx	xx xx xx xx		x		
C11. Implicit Inf. Rdg. Comp.	xx xx	xx x xx xx		x		
C12. Rdg. Note Details	xx xx xx x	xx x xx	x			
C13. Rdg. for Inference	xx xx xx	xx xx xx x	xx x			
S1. Speeded Close Rdg. Comp.	xx xx xx xx	x x x			x x x	x
S2. Chapman Cook Spd. Rdg.	xx xx xx xx	x x x x			xx x	

* For each test, the first row of crosses represents significant factor loadings for the group of middle class boys, subsequent rows providing similar information for middle class girls, lower class boys and lower class girls respectively.

Given that the actual factor composition of the total test battery differed in some respects from the hypothesised factor composition, e.g. Knowledge of Word Meanings included the two hypothesised factors of phonological-orthographic competence and vocabulary knowledge, and Semantic Context replaced Syntactic Comprehension, the skills measured by different types of reading comprehension test can be ascertained from Table 4.9. It is apparent that different types of reading comprehension test involving the comprehension of passages largely measure the same skills, viz. knowledge of word meanings and semantic context or apprehension of the semantic meaning of the passage. These include tests of the multiple choice type (C1, C2, C3, C10, C11, C12, C13), of the close type (C4, S1) and of the chunked type (C5). These tests have sporadic loadings only on the other factors.

The pattern of loadings for the Reasoning factor suggests that the only reading comprehension tests in which reasoning forms a significant component are the Following Instructions tests. Table 4.9 shows that contrary to expectations, none of the tests of implied meaning (C2, C11 or C13) were represented to any appreciable extent on the reasoning factor; indeed, Appendices E.1 to E.4 indicate that loadings for the implied meaning version of a test tended to be smaller than those for the literal or explicit meaning version e.g. C2 vs. C1, C11 vs. C10, C13 vs. C12. Thus in the present study reading comprehension tests calling for an understanding of the implicit meaning of a passage do not appear to require any skills additional to those employed in tests of reading for literal meaning.

It is of particular interest to note that the influence of grammatical or syntactic skills was no more in evidence for the close tests than for any other form of reading comprehension test. Speeded tests of reading comprehension, however, involve a perceptual speed factor which is generally not evident in non-speeded reading comprehension tests.

What Table 4.9 does reveal is a clear differentiation between reading comprehension tests requiring the understanding of passages and those calling for the understanding of single sentences only. The latter tests, viz.

Comprehension of Questions, Comprehension of Statements, and Following Instructions A and B tend to have more substantial loadings on the Sentence Comprehension factor than do the other tests of reading comprehension, which in most cases have non-significant loadings. The tests of Following Instructions present a further contrast with other tests of reading comprehension in that they tend to have non-significant loadings on the semantic context factor. In effect, these tests do not require an understanding of the broader context of a message being conveyed in the passage or sentence, but merely an understanding of a printed instruction. They tend also to involve reasoning to a greater extent than other reading comprehension tests.

The question as to "what skills are being measured by different types of reading comprehension test" can be answered then in this way. Four broad types of reading comprehension test can be distinguished:

Type 1. Tests requiring the understanding of simple instructions

Type 2. Tests requiring the understanding of simple one-sentence questions or statements

Type 3. Tests requiring the understanding of material presented in passages, without distinction as to whether the tests are of multiple-choice, cloze or chunked form.

Type 4. Speeded tests requiring the understanding of material presented in passages.

Type 1 tests of reading comprehension measure knowledge of word meanings, apprehension of the meaning of single sentences, and to a small extent, reasoning. Type 2 tests measure knowledge of word meanings, and apprehension of the meaning of single sentences and of the broader context of those sentences. Type 3 tests, the type most commonly employed to assess reading comprehension, measure knowledge of word meanings, and apprehension of the contextual meaning of the passages to be comprehended. Type 4 tests measure similar skills to Type 3, but in addition measure speed of perceptual processing of the printed material.

As an additional check on this proposed classification of tests, a number of maximum likelihood factor analyses were undertaken for the fifteen reading comprehension tests alone. These indicated that there were three significant factors for the middle class groups and four for the lower class groups.* Since different types of reading comprehension test might be expected to have some if not most abilities in common, oblique rotations were obtained for the unrotated factor solutions. The results set out in Table 4.10 are based on the delta values yielding the best approximation to simple structure.

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* A study of the effects on the factor solutions of different methods of scaling the original raw score distributions ((a) stanine scores for 8 variables, normalised T scores for 7 variables with skewed distributions; (b) stanine scores for 8 variables, dichotomous or 3 point normalized scores on the other 7 variables; (c) stanine scores for 8 variables, and actual raw scores for the other 7 variables) indicated that there were slight differences in the number of factors declared as significant, but revealed little variation in factor composition, except in the choice of the singlet tests defining the additional "significant" factors. Scaling method (a) has been adopted in this 15 variable study as in the main 42 variable study.

Table 4.10. Direct oblimin solutions of maximum likelihood factors for fifteen tests of reading comprehension

Factor Loadings (>.30)

Tests	Middle Class Boys (Delta=0) I	II	III	Middle Class Girls (Delta=0) I	II	III
C1. Basic Skills, Literal Mng.	.56			.74		
C2. Basic Skills, Implied Mng.	.50	.35		.89		
C3. Mult. Choice Rdg. Comp.	.33	.40		.60		
C4. Cloze Reading Comp.		.57		.52		
C5. Chunked Reading Comp.		.43		.58		
C6. Comprehension Questions		.65		.53		
C7. Comprehension Statements		.63		.69		
C8. Following Inst. A		.56			.62	
C9. Following Inst. B		.77		.42	.45	
C10. Explicit Inf. Rdg. Comp.	.85			.85		
C11. Implicit Inf. Rdg. Comp.	.68			.60		
C12. Rdg. Note Details	.57			.57		
C13. Rdg. for Inference	.39			.68		
S1. Speeded Cloze Reading Comp.			.55			.96
S2. Chapman Cook Spd. Rdg.			.95	.56		

Factor	Factor Correlations I	II	III	Factor Correlations I	II	III
I		.73	.55		.43	.52
II			.57			.15

Tests	Lower Class Boys (Delta=-.5) I	II	III	IV	Lower Class Girls (Delta=-1.0) I	II	III	IV
C1. Basic Skills, Literal Mng.	.46				.69	.33		
C2. Basic Skills, Implied Mng.	.87				.32	.36		
C3. Mult. Choice Rdg. Comp.	.49				.60			
C4. Cloze Reading Comp.	.56				.80			
C5. Chunked Reading Comp.	.53				.73			
C6. Comprehension Questions			.66		.37			
C7. Comprehension Statements	.42		.39		.55			
C8. Following Inst. A	.47				.52			
C9. Following Inst. B	.67				.41			.34
C10. Explicit Inf. Rdg. Comp.		.92				.62		
C11. Implicit Inf. Rdg. Comp.		.37				.43		
C12. Rdg. Note Details	.80							.96
C13. Rdg. for Inference	.85				.30		.48	
S1. Speeded Cloze Reading Comp.	.50						.52	
S2. Chapman Cook Spd. Rdg.	.67						.53	

Factor	Factor Correlations I	II	III	IV	Factor Correlations I	II	III	IV
I		.61	.62	.25		.45	.61	.58
II			.44	.12			.27	.34
III				.14				.37

The solutions in Table 4.10 show some consistency among themselves and also with the factors identified earlier in this chapter. At the same time there are differences among the solutions which may reflect a hierarchy of degree of language development among the groups.

Factor I in Table 4.10 seems to be largely concerned with the extraction of information from passage type reading comprehension tests, resembling the factor labelled semantic context earlier in this chapter. It is of some note that two of the tests with high loadings on this factor viz. Explicit and Implicit Reading Comprehension break away to form an additional factor (Factor II) in the lower class groups. Factor II for the middle class groups and Factor III for lower class boys resembles the sentence comprehension factor defined earlier, being represented mainly by Comprehension of Questions, Comprehension of Statements and/or Following Instructions A and B. The loadings on Tests S1 and S2 indicate that Factor III, except in the case of lower class boys, is a speed of reading factor. There were no significant loadings on Factor IV for lower class boys, and the factor is almost specific to the reading to note details test for lower class girls.

The absence of factors distinguishing tests of literal or explicit reading comprehension (Basic Skills Literal Meaning, Explicit Information Reading Comprehension, Reading to Note Details) from tests of inferential reading comprehension (Basic Skills Implied Meaning, Implicit Information Reading Comprehension, Reading for Inference) was noted on page 70 and is confirmed in Table 4.10. Even when this sub-set of six tests was factor analysed independently to yield two significant factors for the four class-sex groups, the factors did not contrast the literal comprehension with the inferential comprehension tests. The question of distinguishing between literal and inferential comprehension is taken up again in Chapter 5.

The identification of a separate factor for the Explicit and Implicit Reading Comprehension tests among the lower class groups suggests that the task of discerning whether an answer agrees with or contradicts or is irrelevant to the information given in a passage is differentiable from, and possibly easier than, the task of finding answers to questions which call for more weighing of alternatives and more interpretation of the meaning of the passage.* The two skills are nevertheless substantially correlated, the correlations being .61 in one group and .45 in the other. With the increased level of language development in the middle class groups, however, the "explicit-implicit" or "logically-derived-question comprehension factor" is absorbed into the more general semantic context factor. The differentiability of reading comprehension tests may therefore depend on the level of language development of the groups to which they are applied, being a little more evident among lower class than middle class groups. Despite this tendency for factors to merge in some groups, the solutions in Table 4.10 suggest that there are experimentally distinguishable types of reading comprehension test, and that they conform with the types indicated on page 71, with perhaps one additional intermediate type (Type 3), thus:

Type 1. Tests requiring the understanding of simple instructions.

Type 2. Tests requiring the understanding of simple one-sentence questions or statements.

Type 3. Tests requiring the understanding of material presented in passages, in which suggested answers either agree with, contradict or are irrelevant to the material presented.

Type 4. Tests requiring the understanding of material presented in passages, with questions requiring more interpretation of shades of meaning than in Type 3.

Type 5. Speeded tests requiring the understanding of material presented in passages.

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* The measures of Explicit and Implicit Reading Comprehension were the only instances in which the questions for each of the two tests were derived from the same passages. While this could explain the emergence of a separate factor defined by these two tests, this explanation is discounted as it would have applied equally to the middle class groups.

C. IS IT PRACTICABLE TO ASSESS COMPREHENSION WITHOUT INFERENCE?

The results presented in this section relate to a third major question of the study:

Is it practicable to assess comprehension without at the same time assessing a person's inferential abilities?

Several reasoning tests were included in the battery as measures of the ability of the children to draw inferences. Five of these tests, comprising Verbal Intelligence and four sub-scores from the Progressive Matrices Test 1938, yielded a Reasoning factor common to the factor solutions (Factor B) for the four class-sex groupings. Measures of word and sentence order and of syntactic comprehension, and also some measures of reading comprehension had been hypothesized to involve little or no reasoning or inference and thus were expected to have non-significant loadings on such a factor. (See first data column of Table 4.11). Other tests of reading comprehension were thought to require a moderate or substantial degree of inference on the part of the pupil, and were expected to have significant loadings on the factor. If these expectations were confirmed, it would be possible to distinguish between comprehension tests which involved inferential abilities and those which did not. The relevant results are set out in summary form in Table 4.11, together with the loadings of the same tests on the Semantic Context factor, for reasons to be stated later. The table is based on the significant factor loadings presented earlier in this chapter for Factor B (Reasoning) and Factor C (Semantic Context). Again, two crosses represent factor loadings of .40 and above, and one cross represents loadings from .30 to .39.

Table 4.11. Factor loadings ≥.30 of Syntactic, Comprehension and Reasoning Tests on Reasoning and Semantic Context Factors

	Hyp* ldg. Reas.	Loadings on Reasoning Factor				Loadings on Semantic Context Factor			
		MCB	MCG	LCB	LCG	MCB	MCG	LCB	LCG
Measures of Word and Sentence Order									
G5. Scrambled Sentences			x	x	x	x	x	xx	xx
G6. Combining Sentences			xx			x	xx	xx	xx
Measures of Syntactic Comprehension									
G7. Compreh. of Sent. Struct.						x		x	
G8. Anaphora						x	xx	x	xx
G9. Embedded Sentences							x		xx
G10. Recovery of Deep Structure			xx	x		x	x	xx	xx
G11. Ambiguous Sentences									
Tests of Reading Comprehension									
C1. Basic Skills Literal Mng.	x		xx			xx	xx	xx	xx
C2. Basic Skills Implied Mng.	xx					xx	xx	x	xx
C3. Mult. Choice Rdg. Comp.	xx		x			xx	xx	xx	xx
C4. Cloze Rdg. Comp.	x							x	
C5. Chunked Rdg. Comp.	x		x			xx	xx	xx	xx
C6. Comprehension Questions	x					x	xx	xx	
C7. Comprehension Statements						xx	xx	xx	xx
C8. Following Inst. A			x		x			x	
C9. Following Inst. B	x	x	xx	x	x		x	x	
C10. Explicit Inf. Rdg. Comp.	x		x			xx	xx	xx	xx
C11. Implicit Inf. Rdg. Comp.	xx		x			xx	x	xx	xx
C12. Rdg. Note Details	x					xx	x		xx
C13. Rdg. for Inference	xx					xx	xx	xx	x
Measures of Reasoning									
R1. Letter Grouping	xx								
R2. Prog. Matrices 38, A+B	xx	xx	xx	xx	xx				
R3. Prog. Matrices 38, C	xx	xx	xx	xx	xx				
R4. Prog. Matrices 38, D	xx	xx	xx	xx	xx		x		
R5. Prog. Matrices 38, E	xx	xx	x	xx	xx				
R6. Thurstone Reasoning	xx								
R7. Verbal Intelligence	xx	x	xx	x		x		x	x
Measures of Processing Speed									
S1. Speeded Cloze Rdg. Comp.	x					x		x	x
S2. Chapman Cook Spd. Rdg.						x	x	x	x

* Hypothesized loading on reasoning factor.

Table 4.11 reveals a general absence of significant loadings of the syntactic and reading comprehension tests on the Reasoning factor, with the partial exception of the results for Middle Class Girls. Since the "Reasoning Factor" section of the table indicates that most of the syntactic and comprehension tests do not involve "reasoning", it would be possible to conclude that it is practicable to assess comprehension without inference; and that in fact most of the syntactic and reading comprehension tests studied already do this. The results, however, when considered across the four groups, call into question the adequacy of the identified Reasoning factor as an appropriate measure of inference; not only do the tests hypothesized to involve no inference in fact involve no inference, but most of those hypothesized to involve moderate or substantial inference also involve no inference. In effect, with the exception of the Following Instructions B test, none of the reading comprehension tests, whether inferential in design or not, appear to depend to any degree on the type of inference involved in these standard tests of reasoning. It is possible, however, that a different type of inference is called for in comprehension tests, involving the weighing of evidence and the integration of facts and relationships presented in different parts of a passage. Taking this broader definition of inferential abilities, the possibility of differentiating between inferential and non-inferential measures of comprehension was considered in respect of the loadings of the tests on the Semantic Context factor in Table 4.11.

The loadings of the tests on the Semantic Context factor suggest that if inferential abilities are taken to include the apprehension of the wider meaning of sentences and passages as well as the abilities measured by the reasoning tests, the only tests of comprehension that would be close to being "inference-free" are Comprehension of Sentence Structures and Following Instructions A, whose loadings on the factors are .32 and .33 only. The claims for the Close test to be included within this category are counterbalanced by the loadings of the Speeded Close test. Considering both factors together, it appears to be practicable to assess comprehension in the form adopted in Comprehension of Sentence Structures and the Following

Instructions A tests without assessing at the same time a person's inferential abilities.

This section completes the analyses required to answer the three main questions to which the study was addressed. A number of subsidiary analyses were undertaken, however, to explore more completely the considerable amount of information collected about the comprehension skills of Grade 6 children, and these are reported in the remaining sections of the chapter.

D. DEGREE OF MASTERY OF SELECTED LANGUAGE SKILLS

1. The Concept of Mastery

Since the major purpose of the study was to identify the components of reading comprehension, most of the tests were constructed in such a way that they would spread the scores of Grade 6 children over the working range of scores. Some tests, however, were included as measures of basic language skills in which children might be expected to have a high degree of competence as a pre-requisite to being able to read passages with comprehension. These comprised tests of proficiency in sound-symbol correspondences, and tests designed to assess sentence comprehension in a relatively pure form. Because of the presumed importance of mastery of these skills in the process of reading comprehension, an analysis was made of the actual degree of mastery attained.

Mastery is a rather more difficult concept to define than the term itself implies. A child can be said to have mastered an item, or more precisely, the skill reflected in that item if he answers the item correctly. But when the particular language skill is assessed on the basis of a number of items, as it usually must be in order to arrive at a reliable measure of the skill, the question of whether a child has mastered a skill does not admit of such a precise answer. In this case, mastery probably has to be interpreted as near-perfect rather than perfect scores on the total collection of items, to allow for the occasional lapses in performance or misunderstandings that may occur even among highly skilled people in an activity.

A further problem with the notion of mastery is that while it is usually judged in relation to the particular set of test items selected to measure the language skill in question, there is some arbitrariness in the choice of items for a test. It would presumably be possible to develop a list of very simple spoken words whose corresponding printed symbols could be recognised by almost all Grade 6 children. Such words, however, would represent only a small part of the total pool of spoken words commonly heard and employed by children at this grade level. It is appropriate therefore, even with a test intended to be a mastery test, to base the test on items which most children of the given grade level might be expected to have mastered. The tests analysed in this section generally meet this criterion, but it is important to keep in mind that the mean scores presented represent the level of mastery attained in relation to the particular set of items included in the test rather than some absolute index of degree of mastery of the given language skill. The fact that a number of types of items which were answered correctly by almost all children in the trial forms of the tests of Comprehension of Sentence Structure and Comprehension of Anaphoric Expressions were excluded from the final tests because of space and time considerations serves to emphasize this point.

Despite these interpretive difficulties, the tests discussed should provide a reasonable indication of the extent to which the various language skills have been mastered by Grade 6 children. They also allow useful comparisons to be made of the relative degree of mastery of the skills by boys and girls from different socio-economic areas. These comparisons are based not only on the mean scores and standard deviations for each sub-group on each test, but also on the percentage of children attaining a particular score level on the test. Although arbitrarily chosen, this score level has been selected to represent a reasonable level of mastery.

Comparisons among the mean scores of the sex and socio-economic groups have been expressed in terms of general statements about trends. Although neither the schools nor the children were selected at random from their relevant populations, formal tests of statistical significance were applied as an aid to interpretation. The results presented under "Grouped Categories" for all middle class and all lower class children, and for all boys and all girls, make no allowance for the different ratios of boys to girls within the socio-economic class groups, but closely approximate the means and percentages which would be obtained by equal weighting procedures.

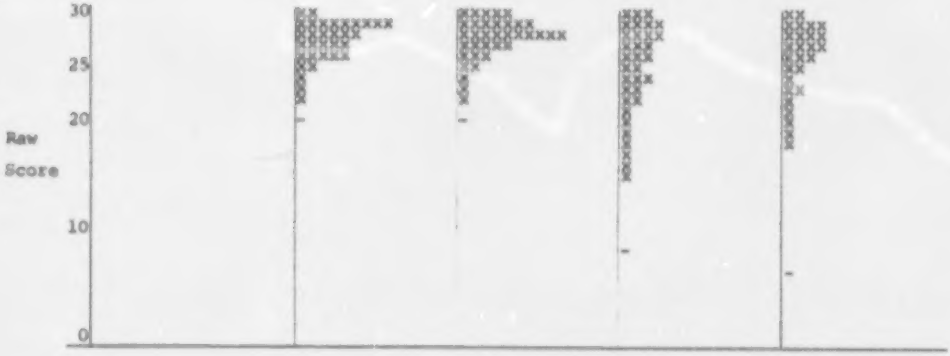
2. Mastery of Sound-Symbol Correspondences

Data from the phonological-orthographic tests allowed the level of mastery of sound-symbol correspondences to be determined.

The degree to which children were able to connect a spoken word with its corresponding printed form was assessed by means of the Word Sounds test. For each spoken word the children were required to select one of three printed words e.g. taught, thought, sought. The results are presented in Figure 4.1. Each cross in Figure 4.1 and subsequent Figures represents approximately 5 children. The short horizontal line represents the lowest raw score for each group.

Figure 4.1

Raw Score Distribution and associated statistics
for class/sex groups on 30 item Word Sounds test



	MIDDLE CLASS BOYS	MIDDLE CLASS GIRLS	LOWER CLASS BOYS	LOWER CLASS GIRLS
Mean	27.17	27.64	24.89	25.50
S.D.	2.04	1.90	4.25	3.71
N	166	173	155	130
% with ⩾ 25 correct	89%	94%	61%	70%

GROUPED CATEGORIES

	MIDDLE CLASS	LOWER CLASS	BOYS	GIRLS
Mean	27.41	25.17	26.06	26.72
S.D.	1.98	4.02	3.29	2.82
N	339	285	321	303
% with ⩾ 25 correct	91%	65%	76%	83%
	$t = 9.11, p < .01$		$t = 2.70, p < .01$	

In line with expectations, the histograms in Figure 4.1 show that substantial proportions of boys and girls obtained perfect or near-perfect scores on this test. Mean scores were generally high. They were higher for girls than for boys, and for pupils in the middle class school areas than in the lower class areas. But the histograms and the associated statistics also reveal a lack of mastery of sound-symbol connections among a considerable proportion of children from lower class areas. If a score of 25 on the 30 item test were taken as the approximate level of mastery of sound to symbol recognition needed by children to be proficient in reading, only 65% of children from schools in lower class areas and only 42% of children from the poorest performing school could be said to have "mastered" this skill as against 91% of children from schools in middle class areas. The score level of 25 is of course arbitrary, but it represents the number of items in the test which were answered correctly by more than 80% of the children.

This general pattern of results was also reflected in the Finding Rhymes test.

Taken together, the results for the two phonological-orthographic tests indicated that most children from the middle class schools had mastered the skill of connecting the spoken word and its printed counterpart. The results point, however, to some lack of skill among a considerable percentage of school children in the lower class areas in making sound-symbol connections. With this lack of skill, the task of identifying printed words and the task of reading would be understandably difficult.

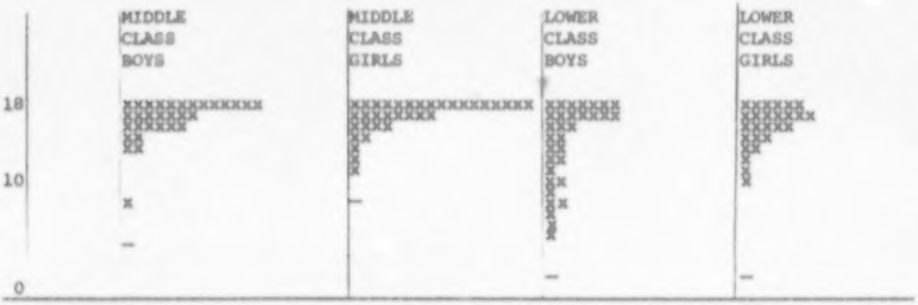
3. Mastery of Sentence Comprehension

It would presumably be possible to locate passages of 50 to 100 words which could be read with complete comprehension by almost all Grade 6 children. Such passages, however, might have to be of a suitably low level of difficulty such that 50% of Grade 3 children, say, could also understand them completely. Reading comprehension tests prepared for a given grade level are usually designed to discriminate among children at that level for the purpose of comparing their relative performance, and near perfect scores are not expected on such tests for more than a few children. While mastery in reading comprehension tests would not normally be anticipated for Grade 6 children because of the greater complexity of comprehension and/or the reasoning likely to be involved in interpreting extended passages, children at this grade level might well be expected to have mastered the process of comprehending simple questions and statements.

Data of relevance to this matter were obtained on three tests. Two of these tests, namely Comprehension of Questions and Comprehension of Statements, were drawn from the test of Sentence Comprehension developed by the Educational Testing Service (1971) as part of an experimental battery to test the level of English comprehension of students from non-English-speaking countries. Children at the Grade 6 level might reasonably have been expected to have obtained near-perfect scores on the Comprehension of Questions test (e.g. When did Tom come here? A. By taxi B. Yes, he did C. To study history D. Last night) and on the Comprehension of Statements tests, which required them to select one of four simple statements which had the same meaning as a stimulus statement. The results obtained by the children on the Comprehension of Questions test are set out in Figure 4.2.

Figure 4.2

Raw Score Distribution and associated statistics for class/sex groups on 18 item Comprehension of Questions test



Mean	16.16	16.82	14.18	15.82
S.D.	2.68	1.68	4.21	2.71
N	166	173	155	130
% with ≥15 correct	85%	90%	61%	82%

GROUPED CATEGORIES

	MIDDLE CLASS	LOWER CLASS	BOYS	GIRLS
Mean	16.50	14.92	15.21	16.39
S.D.	2.25	3.69	3.64	2.24
N	339	285	321	303
% with≥15 correct	88%	70%	73%	87%

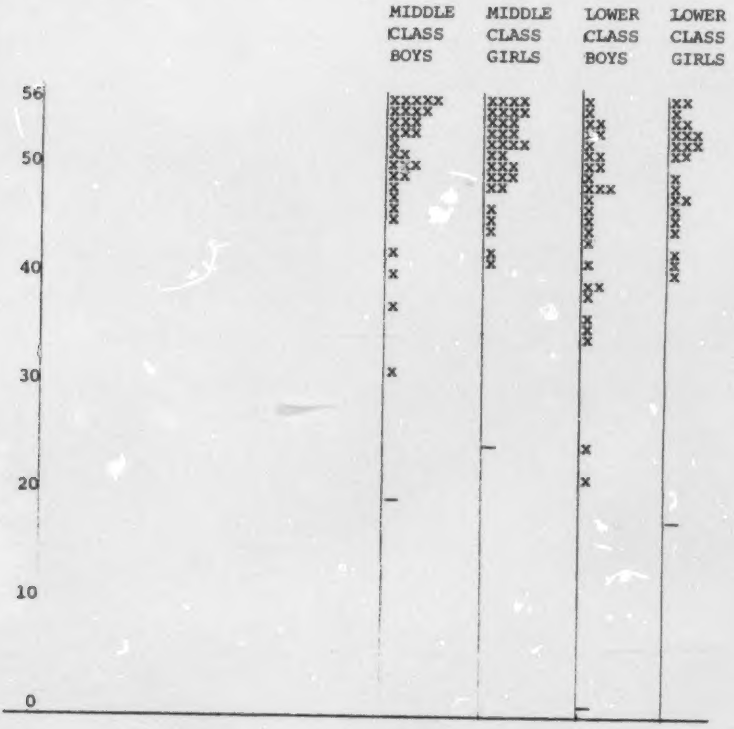
$t = 6.58$, $p < .01$ $t = 4.88$, $p < .01$

While the analysis in Section C of this Chapter suggested that performance on the Comprehension of Questions test was dependent upon an appreciation of the semantic context of the questions, it would appear to be a suitable test for assessing mastery of simple comprehension. Questions and responses are simple in form, but the reader must have understood the question to be able to select the most appropriate answer to it. Figure 4.2 shows that most children in schools in the middle class areas can be said to have mastered the skill of sentence comprehension in this form, and that approximately three-quarters of children in lower class areas might be regarded as having mastered the skill. When sentence comprehension was tested by requiring children to select a statement equivalent to a stimulus statement, however, as in the Comprehension of Statements test, the estimate of degree of mastery of sentence comprehension skills was somewhat lower, the percentage of children with 15 or more correct answers in the 18-item test being 58% for middle class boys, 72% for middle class girls, 44% for lower class buys and 47% for lower class girls.

The third measure of sentence comprehension on which Grade 6 children might have been expected to demonstrate a high level of mastery was the Comprehension of Sentence Structures test. Children were merely required to write answers of one or two words or of short phrases to indicate that they had grasped the meaning conveyed in a short sentence such as "The dog ate the biscuits which were on the table." In response to the question, "What ate the biscuits?" they would usually write "The dog." The results obtained on this test are presented in Figure 4.3.

Figure 4.3

Raw Score Distribution and associated statistics for class/ sex groups on 56 item Comprehension of Sentence Structures test



	MIDDLE CLASS BOYS	MIDDLE CLASS GIRLS	LOWER CLASS BOYS	LOWER CLASS GIRLS
Mean	48.95	50.31	42.99	47.96
S.D.	7.81	5.44	11.25	7.85
N	166	173	155	130
% with ≥50 correct	62%	66%	36%	55%

GROUPED CATEGORIES

	MIDDLE CLASS	LOWER CLASS	BOYS	GIRLS
Mean	49.65	45.25	46.07	49.30
S.D.	6.73	10.14	10.06	6.68
N	339	285	321	303
% with ≥50 correct	64%	44%	49%	61%

t = 6.45, $p < .01$ t = 4.69, $p < .01$

It is readily apparent from Figure 4.3 that the Grade 6 children had by no means mastered the comprehension of short sentences representing the range of sentence structures employed in this test. Girls showed a greater degree of mastery than boys, and children from middle class areas attained greater mastery than those from lower class areas, but none of the four class/sex groups attained a high degree of mastery. This result is probably due to the fact that while the sentence statements were short, some were syntactically more complex than others e.g. "His jumping over the wall gave him the race" as compared with "The mirror on the wall was cracked." Also, four different types of question (rote, transform, semantic substitute and compound) were employed to elicit the answer, and the differing syntactic demands of these questions may have further served to obscure children's understanding of the meaning of some of the statements.

The children can thus be said to have demonstrated mastery of sentence comprehension when this requires the selection of appropriate forms of answer to simple questions, but not with respect to the selection of paraphrased statements of a stimulus sentence, nor in relation to short sentences of some syntactic complexity.

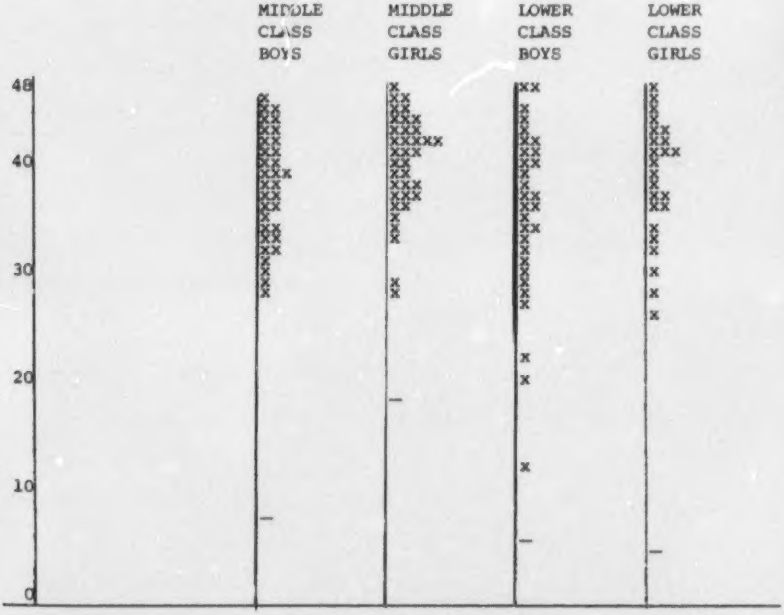
4. Mastery of Sentence Linking Devices

In a passage of any length, a reader is likely to encounter a number of linguistic devices for linking a sentence with the one preceding it. Given the amount and variety of reading undertaken by children during their primary school years, they might reasonably be expected to have mastered most of these devices at the completion of their primary schooling.

The results of the children on the test of Comprehension of Anaphoric Expressions, which are set out in Figure 4.4, provide some indication of the degree to which they have mastered such sentence linking devices. In interpreting these results, account needs to be taken of the fact that although the sentences themselves were simple, different types of questions were used to test whether children had grasped the meaning. For example, comprehension of the sentence pair, "Mary was hungry. She bought two cakes", could be assessed by asking "Who bought two cakes" or "By whom were the cakes bought", etc.

Figure 4.4

Raw Score Distribution and associated statistics for class/ sex groups on 48 item Comprehension of Anaphoric Expressions test



Mean	37.07	39.57	33.78	36.86
S.D.	6.76	5.11	10.02	7.49
N	166	173	155	130
% with ⩾ 40 correct	40%	58%	34%	44%

GROUPED CATEGORIES

	MIDDLE CLASS	LOWER CLASS	BOYS	GIRLS
Mean	38.35	35.18	35.48	38.41
S.D.	6.10	9.07	8.64	6.38
N	339	285	321	303
% with ⩾ 40 correct	49%	39%	36%	52%
	$t = 5.17, p < .01$		$t = 4.78, p < .01$	

In conformity with the prevailing pattern, Figure 4.4 reveals that there is a greater degree of mastery of anaphoric expressions for girls than for boys, and for schools in middle class areas than for schools in lower class areas. Nevertheless, less than half of the children in either the middle class area or lower class area schools could attain scores of 40 or more on this test. It is true that the children had mastered a good number of the sentence linking devices. But even allowing for the effect of using questions other than direct rote questions to test comprehension, many linking devices remain to be mastered.

5. Mastery of simple printed instructions

Carroll (1971b, 1971c) has suggested that a test designed to assess children's ability to follow printed instructions might prove to be a valid measure of comprehension. The Following Printed Instructions Test was prepared for this purpose. Those items which were answered correctly by a very high proportion of children were grouped into a sub-test (Following Printed Instructions A) which was thought might serve as a measure of pure reading comprehension.

The items required the children to carry out tasks which could be expected to be very simple for Grade 6 classes, so that it was essentially the children's ability to understand the printed instructions which was being assessed. Sample questions were:

(a) Write the name of your school and then your class.

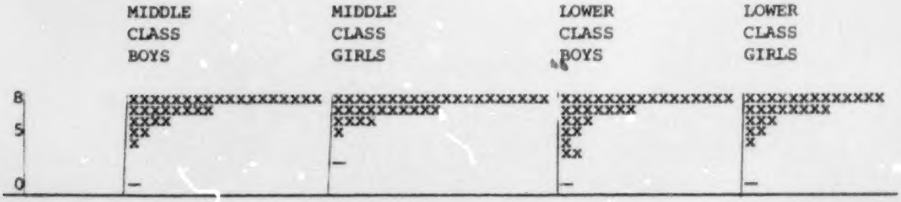
(b) Count the number of letters in the word BEGINNING. If the number of letters is less than 10 write YES, if it is 10 or more write NO.

(c) Here is a list of numbers: 8 4 3 7 9 0 6. Write the same numbers in the opposite order.

Since the level of comprehension demanded by these items seemed minimal for Grade 6 children, high mean scores were expected. Results are presented in Figure 4.5.

Figure 4.5

Raw Score Distributions and associated statistics for class/ sex groups on 8 item Following Printed Instructions Test A



	MIDDLE CLASS BOYS	MIDDLE CLASS GIRLS	LOWER CLASS BOYS	LOWER CLASS GIRLS
Mean	7.15	7.38	6.88	7.08
S.D.	1.23	0.84	1.65	1.31
N	166	173	155	130
% with ≥7 correct	78%	85%	74%	79%

GROUPED CATEGORIES

	MIDDLE CLASS	LOWER CLASS	BOYS	GIRLS
Mean	7.27	6.97	7.02	7.25
S.D.	1.05	1.50	1.45	1.08
N	339	285	321	303
% with ≥7 correct	82%	76%	76%	82%

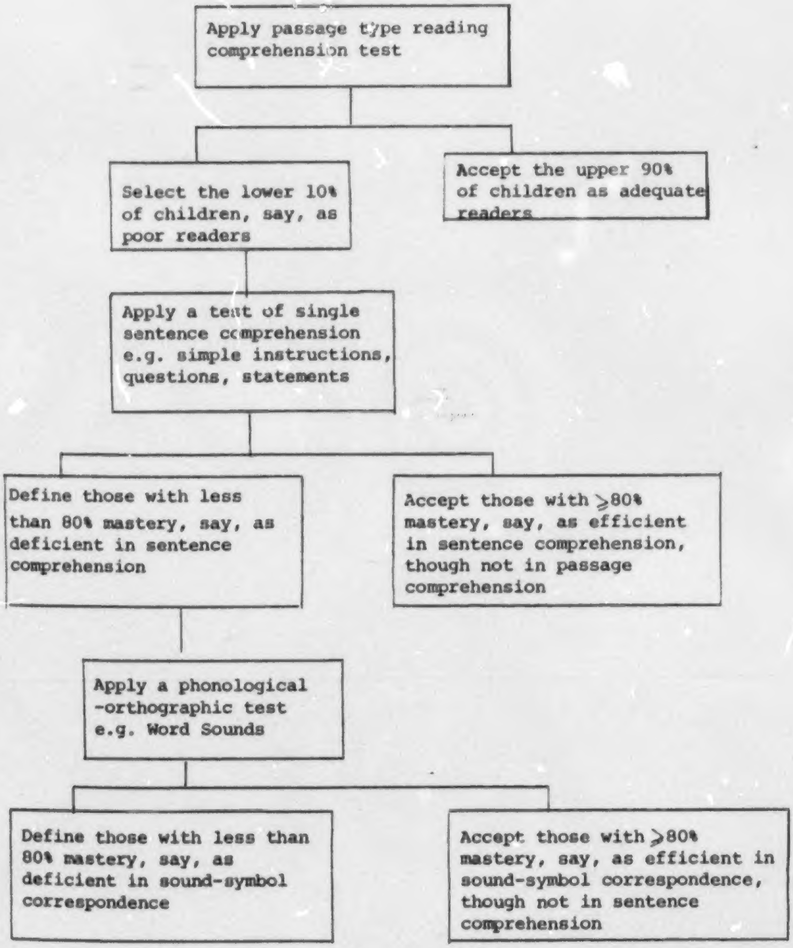
$t = 2.89$, $p < .01$ $t = 2.25$, $p < .05$

These results indicate that Grade 6 children in general have mastered the skill of comprehending simple printed instructions. In contrast with other tables in this section, the mean scores for the children from lower class areas approach those of children from the middle class areas, and the usual marked discrepancy between the percentages of children from the two areas attaining given score levels does not occur. This type of test appears to be one of the most promising forms of measuring pure comprehension.

E. A POSSIBLE DIAGNOSTIC PROCEDURE

The analysis in Section B of this chapter led to the suggestion that there were five experimentally distinguishable types of reading comprehension test, ranging from tests requiring the understanding of simple instructions to tests calling for the understanding of material presented in passages. In Section C it was indicated that at least some tests of comprehension were relatively inference-free, while Section D has demonstrated that a substantial number of Grade 6 children achieve mastery on some of the tests included in the study. When put together, the information generated by these three lines of investigation suggests a possible sequential procedure for group diagnosis of reading comprehension difficulties experienced by primary school children. No attempt has been made to arrange the various types of sentence comprehension test sequentially within this procedure since the tests of Following Instructions were not always clearly differentiated factorially from the Comprehension of Questions and Comprehension of Statements tests.

The procedure can be set out conveniently in flow chart form:


Apply passage type reading comprehension test
Select the lower 10% of children, say, as poor readers
Accept the upper 90% of children as adequate readers
Apply a test of single sentence comprehension e.g. simple instructions, questions, statements
Define those with less than 80% mastery, say, as deficient in sentence comprehension
Accept those with ≥80% mastery, say, as efficient in sentence comprehension, though not in passage comprehension
Apply a phonological -orthographic test e.g. Word Sounds
Define those with less than 80% mastery, say, as deficient in sound-symbol correspondence
Accept those with ≥80% mastery, say, as efficient in sound-symbol correspondence, though not in sentence comprehension

Guttman scaling techniques were employed to test whether the hierarchy implicit in the above flow diagram was tenable for approximately the lowest 10% of children in the full sample on each of the nine unspeeded passage-type tests of reading comprehension. In effect, the scalability of the following type of scale pattern was tested:

	Basic Skills, Literal Meaning	Following Instructions A	Word Sounds
Scale types:	1	1	1
	0	1	1
	0	0	1
	0	0	0

In addition to testing the scalability of the pattern for each of the nine criterion variables, the pattern was examined in relation to four of the single sentence comprehension tests in which mastery might have been expected for a substantial proportion of children. As the results of the Guttman scaling analysis were likely to vary with whatever arbitrary definition of mastery was employed, (a problem which precluded the more extensive use of Guttman analyses in the study), the analysis was carried out for a mastery criterion level of 80% of the highest raw score obtained by any of the children on the test and also for 70% of the highest raw score. Highest raw score was preferred to total possible score for this purpose since the number of score points between actual test ceilings and total possible score was likely to vary considerably from test to test.

The results of the Guttman scaling analyses for the nine criterion variables and the four sentence comprehension variables (Comprehension of Questions, Comprehension of Statements, Following Instructions A, and Comprehension of Sentence Structures) indicated that the Comprehension of Statements test, in conjunction with the Word Sounds test, would classify very efficiently the lowest-scoring 10% (approximately) of children on each of the unspeeded passage-type reading comprehension tests into three categories - those deficient in making sound-symbol connections, those deficient in interpreting single sentences, and those deficient in both of those areas. The efficiency of the Comprehension of Statements test for this purpose was considerably higher than the efficiency of Comprehension of Questions, Following Instructions A or Comprehension of Sentence Structures, both in terms of the total percentage of the children categorized into the two types of reading deficiency, and the extent to which sound-symbol deficiencies could be regarded as a prior stage of reading difficulty to sentence interpretation deficiencies, as represented by the coefficient of scalability (Nie et al, 1975). The results of the Guttman scaling analysis are therefore presented only for the Comprehension of Statements and Word Sounds tests in Table 4.12; the differing numbers of cases in the lowest-scoring 10% for the different passage-type reading comprehension tests is due to the fact that the 10% of the 624 cases was taken to include all children with raw scores at the level nearest to the tenth percentile point on the raw score scale.

Table 4.12. Number of children in lowest-scoring 10% (approximately) of each unspeeded passage-type reading comprehension test who failed to attain mastery level on Word Sounds and/or Comprehension of Statements tests, and associated statistics

Passage-type reading comprehension test	Mastery criterion % of highest obtained raw score on Word Sounds and Comp. Statements	A. Deficient in Sound-Symbol connections (Word Sounds) and Sentence Interpretation (Compreh. Statements)	B. Deficient in Sound-Symbol Connections only	C. Deficient in Sentence Interpretation only	D. Deficient in neither sound-symbol connections nor sentence interpretation	Percentage of cases diagnostically categorised	Coefficient of scalability
Basic Skills, Lit. Mng.	80%	33	2	34	2	97%	.90
(N=71)	70%	14	0	43	14	80%	1.00
Basic Skills, Imp. Mng.	80%	34	0	33	8	89%	1.00
(N=75)	70%	17	0	38	20	73%	1.00
Mult. Choice Rdg. Comp.	80%	40	3	24	2	97%	.81
(N=69)	70%	19	3	40	7	90%	.81
Cloze Rdg. Comp.	80%	40	0	19	3	95%	1.00
(N=62)	70%	24	0	29	9	85%	1.00
Chunked Rdg. Comp.	80%	34	1	19	4	93%	.93
(N=58)	70%	15	2	29	12	79%	.87
Explicit Inf Rdg Comp	80%	18	1	28	7	87%	.93
(N=54)	70%	8	1	31	14	74%	.92
Implicit Inf Rdg Comp	80%	25	0	33	6	91%	1.00
(N=64)	70%	11	0	31	22	66%	1.00
Reading Note Details	80%	23	0	25	7	87%	1.00
(N=55)	70%	15	1	22	17	69%	.94
Reading for Inference	80%	23	1	19	4	91%	.93
(N=47)	70%	12	0	26	9	81%	1.00

Table 4.12 is read as follows:

> Of the 71 children in the lowest-scoring 10% on the Basic Skills test of Literal Meaning, 33 could be classified as deficient in making sound-symbol connections and in sentence interpretation, 2 could be classified as having mastered sentence interpretation although deficient in sound-symbol connections (thus reducing the coefficient of scalability from 1.00 to .90), and 34 could be classified as deficient in sentence interpretation only. Thus 69 (97%) of the 71 children could be diagnosed as deficient in sound-symbol connections and/or sentence interpretation skills.

It is apparent from data columns 5 and 6 of Table 4.12 that an 80% mastery criterion level achieves a more complete categorisation of the lowest-scoring ten per cent of cases on each criterion variable than does the 70% mastery criterion, and this was found to be the case in the analyses based on the other three sentence comprehension variables. The scalability of the two-category scale varies little for the 80% and 70% mastery levels. The application of the Word Sounds and Comprehension of Statements tests to children with relatively low scores on the passage-type reading comprehension tests would thus indicate quite efficiently whether the children's difficulties lay in decoding the printed word symbols or in arriving at the meaning of a sentence when expressed in paraphrased form.

It is not claimed that this particular combination of tests is the only pair that would yield an efficient classification into diagnostic categories. Other single sentence tests might be substituted for Comprehension of Statements, and other tests of phonological-orthographic competence or perhaps of vocabulary knowledge might replace Word Sounds. The analysis undertaken in this section, however, outlines one combination of tests which could be expected to work efficiently for large-scale diagnostic screening purposes.

F. SEX AND SOCIO-ECONOMIC CLASS DIFFERENCES IN LANGUAGE AND ASSOCIATED SKILLS

In research studies on language, it has been commonly found that girls perform better than boys, and middle class socio-economic groups better than lower class groups; sources of evidence may be found in Carroll (1971b), Clark (1972) and Thorndike (1973b). Since the present study provided measures of all of the language skills thought to be involved in reading comprehension, it was possible to explore in more detail the nature of sex and class differences in language performance, and to determine, for instance, whether the superiority of girls over boys applied only to reading comprehension or also to the phonological-orthographic and syntactic skills contributing to comprehension.

Comparisons among the four sex x socio-economic groupings are based on the mean scores presented in Table 4.13, together with the standard deviations listed in Appendix F. While the mean scores may be fairly readily compared as they stand, some of the differences would not be significant with samples of the size employed. So although the four groups were not random samples from their respective populations, a Newman-Keuls multiple comparisons test was made of the differences among the four means for each of the skills tested in the battery.* Differences shown by this test to be significant at the .05 level are displayed in diagrammatic form in the last column of the table, and will serve as a guide in drawing conclusions about sex and socio-economic differences in these skills. Groups do not differ significantly if they are joined by a common underline.

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* Sample size was taken as 130 for each group to provide a conservative test of significance.

Table 4.13. Mean Scores of each sex and socio-economic grouping on each test and comparisons among means

	Middle Class Boys (MCB) (N=1[illegible]6)	Middle Class Girls (MCG) (N=173)	Lower Class Boys (LCB) (N=155)	Lower Class Girls (LCG) (N=130)	Order of mean score of four sex x class groups, ranked from highest (left) to lowest
Age (months)	146.38	144.88	147.35	147.22	
Measures of Phonological-Orthographic Competence					
P1. Word Sounds	27.17	27.64	24.90	25.50	MCG MCB LCG LCB*
P2. Finding Rhymes	38.42	40.38	35.12	36.39	MCG MCB LCG LCB
P3. Hidden Words	20.87	21.98	18.31	18.52	MCG MCB LCG LCB
P4. Word Attack	11.67	12.39	10.68	10.37	MCG MCB LCB LCG
Measures of Grammatical or Syntactic Competence					
G1. Word Uses	16.19	16.31	15.11	14.62	MCG MCB LCB LCG
G2. Linguistic Markers	13.20	14.83	11.24	12.49	MCG MCB LCG LCB
G3. Punctuation A	12.64	15.78	11.3[illegible]	13.06	MCG LCG MCB LCB
G4. Punctuation B	11.12	14.86	9.44	11.92	MCG LCG MCB LCB
G5. Scrambled Sent.	10.42	12.38	8.71	10.00	MCG MCB LCG LCB
G6. Combining Sent.	10.03	11.15	8.8[illegible]	10.03	MCG LCG MCB LCB
G7. Compreh. Sent. Struct.	48.96	50.31	42.97	47.95	MCG MCB LCG LCB
G8. Anaphora	37.07	39.58	33.79	36.94	MCG MCB LCG LCB
G9. Embedded Sent.	14.46	15.65	12.91	13.42	MCG MCB LCG LCB
G10. Deep Structure	20.23	22.58	17.81	16.62	MCG MCB LCG LCB
G11. Ambig. Sent.	3.93	4.37	4.04	4.06	MCG LCG LCB MCB
Measures of Lexical Competence					
L1. Voc, no context	21.99	23.23	18.72	1[illegible].02	MCG MCB LCB LCG
L2. English Picture Vocab Test	31.81	29.34	28.89	26.12	MCB MCG LCB LCG
L3. Vocab in context	14.81	15.97	12.46	13.01	MCG MCB LCG LCB
Tests of Reading Comprehension					
C1. Basic Skills Lit. Mng.	9.80	10.21	8.93	8.98	MCG MCB LCG LCB
C2. Basic Skills Imp. Mng.	6.40	6.83	5.16	5.31	MCG MCB LCG LCB
C3. Mult. Choice Rdg. Comp.	12.19	13.11	10.42	11.37	MCG MCB LCG LCB
C4. Cloze Rdg. Comp.	15.23	16.53	13.19	13.65	MCG MCB LCG LCB
C5. Chunked Rdg. Comp.	12.29	12.42	10.76	10.51	MCG MCB LCB LCG
C6. Compreh. Questions	16.17	16.82	14.19	15.82	MCG MCB LCG LCB
C7. Compreh. Statements	14.28	15.22	12.57	13.82	MCG MCB LCG LCB
C8. Following Inst. A	7.16	7.39	6.88	7.08	MCG MCB LCG LCB
C9. Following Inst. B	4.85	5.53	4.34	4.94	MCG LCG MCB LCB
C10. Explicit Inf. Rdg. Comp.	8.51	8.87	7.62	7.42	MCG MCB LCB LCG
C11. Implicit Inf. Rdg. Comp.	3.46	3.67	3.34	3.11	MCG MCB LCB LCG
C12. Rdg. Note Details	6.47	6.66	5.59	5.06	MCG MCB LCB LCG
C13. Rdg. for Inference	8.81	8.98	7.06	6.94	MCG MCB LCB LCG
Measures of Reasoning					
R1. Letter Grouping	14.01	14.72	12.72	13.50	MCG MCB LCG LCB
R2. Prog. Matrices A+B	20.48	21.17	20.24	19.77	MCG MCB LCB LCG
R3. Prog. Matrices C	7.45	7.85	7.19	6.96	MCG MCB LCB LCG
R4. Prog. Matrices D	7.73	8.49	7.14	7.45	MCG MCB LCG LCB
R5. Prog. Matrices E	3.09	3.86	3.12	3.06	MCG MCB LCG LCB
R6. Thurstone Reasoning	14.41	13.40	13.35	12.45	MCB MCG LCB LCG
R7. Verbal Intell. Raw Score	42.83	44.04	37.10	34.07	MCG MCB LCB LCG
- Prog. Mat. Total Raw Score	38.85	41.37	37.70	37.12	MCG MCB LCB LCG
- Verbal I.Q.	108.67	110.61	102.97	100.75	MCG MCB LCB LCG
- Prog. Matrices I.Q.	110.50	115.50	108.37	106.98	
Measures of Processing Speed					
S1. Speeded Cloze Rdg.	8.22	8.36	6.81	6.50	MCG MCB LCB LCG
S2. Chapman Cook Spd. Rdg.	10.39	11.17	8.46	8.70	MCG MCB LCG LCB
S3. First Digit Cancellation	51.99	54.91	53.25	57.82	LCG MCG LCB MCB
S4. Letter A	14.61	16.59	14.54	16.08	MCG LCG MCB LCB

* The interpretation of this comparison is as follows. The mean score of middle class girls does not differ significantly at the 5% level from that of middle class boys, but both of these groups have a significantly higher mean score than lower class girls and lower class boys. The mean scores of the latter two groups do not differ sign'ly.

The most striking feature of Table 4.13 is the predominance of the MCG, MCB, LCG, LCB pattern of rankings across the language skills, i.e. middle class girls tend to do better in most of the language skills than middle class boys, who in turn do better than lower class girls who tend to be superior in performance to lower class boys. Even when this pattern is varied by a reversal of the position of lower class girls and lower class boys, the differences between the two lower class means are generally not large enough to be regarded as significant.

The possibility that the lower mean scores of lower class as against middle class children or of boys as against girls, might be explained by a slower rate of working rather than by an actual difference in potential achievement level was investigated by comparing for the sub-sets of children from the random sample of 104 cases the mean number of items attempted and the mean obtained score on each of the reading comprehension tests and on the phonological-orthographic, grammatical-syntactical and lexical measures. It was found that this could have partly explained the lower mean achievement level obtained in four tests by the LCB group, which included a few boys whose rates of working were considerably slower than those of the remainder of the group, but the hypothesis proved to be untenable in the case of most tests and with respect to the other groups.

Sex and socio-economic class differences in language skills can be conveniently summarized within each of the broad groupings in which the skills were originally categorized:

1. Performance on measures of phonological-orthographic competence

    General pattern: MCG _ _ MCB LCG LCB
    That is, middle class girls tend to be superior to middle class boys.
    Middle class groups are superior to lower class groups.
    There is little difference in the performance of lower class girls and lower class boys.

2. Performance on measures of grammatical and syntactic skills

    General pattern: MCG MCB LCG LCB
    Middle class girls are superior to middle class boys, whose performance is not generally distinguishable from that of lower class girls.
    Lower class boys are inferior in performance to the other groups.
    An exception to the pattern occurs with the Punctuation tests, in which the mean scores of lower class girls as well as of middle class girls exceed the mean scores of the respective boys' groups.

3. Performance on vocabulary tests

General pattern: MCG _ _ MCB LCB or LCG
The English Picture Vocabulary Test provides an exception to the pattern, it being the only test in the battery in which the performance of boys is superior to that of girls within each of the two socio-economic groupings. This reversal of pattern would support the notion that boys have greater difficulty in decoding printed word symbols than girls.

4 Performance on tests of reading comprehension

General pattern: MCG _ _ MCB _ _ LCG _ _ LCB

Each group in the sequence 'middle class girls, middle class boys, lower class girls, lower class boys' tends to be superior in performance to the next group in the sequence.

5. Performance on measures of processing speed

General pattern of speed of reading tests: MCG MCB LCB or LCG
Middle class groups are superior to lower class groups.

General pattern of perceptual speed tests: LCG or MCG LCB or MCB
Girls tend to be superior to boys.
Lower class groups improve their relative position with respect to middle class groups, with lower class girls exceeding the mean score of one or both middle class groups.

6. Performance on measures of reasoning

Pattern for non-verbal intelligence (PM38 total): MCG MCB LCB LCG
Middle class girls are superior to the other three groups.

Pattern for verbal intelligence: MCG MCB LCB LCG
Middle class groups are superior to the lower class groups.
The superiority of the middle class groups over the lower class groups was less marked for the Letter Grouping and Thurstone Reasoning tests.

Differences among the middle class and lower class groups on the verbal and non-verbal intelligence measures are somewhat amplified in respect of I.Q., because of the small differences in mean age as indicated in Table 4.13. It is clear that the middle class groups had considerably higher mean I.Q. ratings (110.61 for girls and 108.67 for boys) than the lower class groups (102.97 for boys and 100.75 for girls) on verbal intelligence tests. This superiority, though still maintained, was less marked for the non-verbal intelligence test (mean I.Q.s of 115.50 for middle class girls and 110.50 for middle class boys as compared with 108.37 for lower class boys and 106.98 for lower class girls), certainly in relation to the boys' groups. The higher mean I.Q.s for the Progressive Matrices test suggest that the current norms might be inflated; one might expect that the lower class groups, if handicapped in language, would obtain higher mean I.Q.s on non-verbal than on verbal intelligence tests, but there is no evidence of the expected accompanying counterbalancing tendency among the middle class groups.

It would be tempting, perhaps, to argue that the middle class groups had attained higher mean scores than the lower class groups on language skills because they were of superior intelligence. It may well be that the mental processes involved in answering intelligence test questions successfully contribute also to the comprehension of written language, though this would be better demonstrated with non-verbal than with verbal intelligence tests which are themselves heavily dependent on language comprehension. But it was not the intention in this section to inquire into the causes of the differences in the mean scores of the sex x socio-economic class groups. The aim was rather to ascertain the extent and generality of the differences in the various language skills among a group of middle class boys and middle class girls drawn from the same mixed school classes, and a group of lower class boys and lower class girls drawn in the same way. What has been demonstrated is that the middle class groups tend to make higher mean scores on almost all of the tests of language, reasoning and speed of reading than do the lower class groups; further, that middle class girls tend to do better on almost all of the tests than middle class boys, while lower class girls show a general but less widespread superiority in performance on the tests than lower class boys. The superiority of girls over boys and of middle class over lower class groups is thus not confined to the broader task of reading comprehension, but applies with minor exceptions to the phonological-orthographic, grammatical, syntactic and lexical skills subsumed in the comprehension of written language.

G. COMPARATIVE DIFFICULTY OF DIFFERENT SYNTACTIC FORMS OF SENTENCES

1. Relative difficulty of left-branching, centre-embedded and right-branching clauses

The test of embedded sentences was included in the battery as a measure of children's proficiency in understanding involved syntactical constructions. It was thought that the degree of proficiency in this skill might be directly associated with performance on reading comprehension tests.

Since Schwartz, Sparkman and Deese (1970) had found a rapid decline in the comprehensibility of sentences when they were extended to include centre-embedded or right-branching clauses, but no decline with the addition of left-branching clauses, it was considered that a test composed of all three types of clauses would provide the necessary level of complex syntactical constructions. In view of the findings of these authors, it was expected that children would reveal a greater level of understanding of sentences with left-branching clauses than of those with centre-embedded or right-branching clauses. The relative difficulty of the three types of sentences for the reduced sample of 104 cases is set out in Table 4.14. Each percentage given in the table represents an average over the class-sex group of the percentage of each sentence type answered correctly by each child in that group.

Table 4.14. Percentage of left-embedded, centre-embedded and right-embedded sentences answered correctly by class/sex groups

Sentence Type	No. of sentences	Middle Class Boys (N=27)	Middle Class Girls (N=30)	Lower Class Boys (N=24)	Lower Class Girls (N=23)
Left-branching clauses	6	76%	69%	61%	68%
Centre-embedded clauses	9	76%	74%	61%	67%
Right-branching clauses	5	74%	70%	63%	68%

Table 4.14 does not support the findings of Schwartz, Sparkman and Deese, obtained with rather more complex sentences applied to graduate students in psychology. For sixth grade children in the Sydney schools concerned, it appears that sentences containing centre-embedded and right-branching clauses are of the same level of comprehensibility as those with left-branching clauses. Boys and girls from lower-class areas demonstrate a lower level of comprehension of all three types of sentences than do their counterparts from middle class areas.

2. Effect of form of question on rating of comprehension

The extent to which a child understands a sentence is usually determined by asking him a question about that sentence. It is possible that the estimate of his level of comprehension varies according to the form of question used to gauge comprehension.

Bormuth's (1970) operational approach to the construction of achievement test items provided a convenient means of exploring this problem. By applying standard linguistic transformations to a base sentence, different forms of questions about the information contained in that sentence are generated. For example, the application of standard rules to the base sentence "The boy rode the steed" produces the following question forms:

(i) Rote Question: Who rode the steed?
(ii) Transform Question: By whom was the steed ridden?
(iii) Semantic Substitute Question: Who rode the horse?
(iv) Compound Question: By whom was the horse ridden?
(combining (ii) and (iii))

Two of the tests employed in the present study, namely Comprehension of Sentence Structures and Comprehension of Anaphoric Expressions were constructed on these lines to provide equal numbers of the four forms of question, each form occurring once in a set of four questions of a given sentence type (Menzel's appendix to Bormuth, 1970), as in the nominalization type of sentence, "He told Tom that the bus was coming." A comparison of the relative difficulty of the four question forms in each of these two tests should indicate whether the estimate of a pupil's comprehension of a sentence is influenced by the form of the question asked.

The percentage of children in each of the four class-sex groupings in the reduced sample who answered each form of each sentence type correctly was calculated. As the relative difficulty of the question forms, when averaged or ranked over the fourteen sentence types was the same for each of the four class-sex groupings, Table 4.15 presents data only for the broader socio-economic and sex and total groupings.

Table 4.15. Average (over 14 sentence types) of the percentages of children answering each question form of each sentence type correctly in test of Comprehension of Sentence Structures

Question Form	Lower Class (N=47)	Middle Class (N=57)	Boys (N=51)	Girls (N=53)	Total (N=104)
Rote	89%	94%	90%	94%	92%
Transform	65%	78%	68%	77%	72%
Semantic Substitute	78%	91%	81%	89%	85%
Compound	71%	85%	75%	82%	79%

Table 4.15 reveals a generally high level of comprehension of the different forms of question, though the rote form is consistently easier than the transform form, being answered correctly by 92% of the children as against 72%. The relative difficulty of the four forms of question is the same for both socio-economic groupings and both sexes, the rote form being the easiest, then the semantic substitute form, then the compound form, with the transform form being the most difficult. As with other comparisons, the percentage of children answering each of the question forms correctly is greater for girls than for boys, and greater still for middle class than for lower class children.

Some question forms appeared to be unusually difficult for the lower class boys group when based on particular sentence types. For example, only 29% of lower class boys could comprehend the sentence type "He had eaten before I entered" when asked a transform or compound form of question, as against approximately 80% when the question asked was in rote or semantic substitute form. In general, lower class boys experienced considerably greater difficulty in understanding sentences containing subordinate clauses of a conditional or causal or time scale kind when comprehension of these sentences was tested by a transform question.

The evidence from Table 4.15 suggests that the form of the question used to assess a child's understanding of a sentence may have an effect on his level of comprehension. To gauge the degree of generality of this effect, an analysis of the responses to the test of Comprehension of Anaphoric Expressions was also undertaken, which yielded the following results:

Table 4.16. Average (over 11 sentence types) of the percentages of children answering each question form of each sentence type correctly in test of Comprehension of Anaphoric Expressions

Question Form	Lower Class (N=47)	Middle Class (N=57)	Boys (N=51)	Girls (N=53)	Total (N=104)
Rote	73%	80%	75%	81%	78%
Transform	70%	79%	72%	77%	75%
Semantic Substitute	69%	80%	74%	77%	76%
Compound	65%	72%	65%	72%	69%

While the superiority of middle class to lower class children, and of girls to boys is again evident in these results, the form of the question appears to have little influence on the comprehension of the material in this case except in relation to compound questions. Transform and Semantic Substitute questions, each involving a single transformation of the base sentence, are comprehended as readily as rote questions, but the double transformation employed in the compound question makes this a little more difficult to comprehend.

The compound question was not the most difficult question to understand in each of the eleven sentence types in this test. Each of the other three forms of question proved to be the most difficult to understand in the case of two or three sentence types.

With respect to the effect of the form of the question on the rating of comprehension, the evidence from the results for the two tests is conflicting. The same pattern of results occurred, however, in the original study of these question forms with Grade 4 children in U.S.A. (Bormuth et.al., 1970). Although their level of comprehension was understandably lower in terms of their age, and the transform question in Comprehension of Sentence Structures compared more favourably with other forms, (percentage answering correctly being 77% for rote form, 71% for transform form, 69% for semantic substitute form and 67% for compound question form), the percentages correct for each form of question differed significantly for this test but not in the case of Comprehension of Anaphoric Expressions.

In general, the results presented in this section demonstrate that the level of a child's comprehension of a statement may be affected for some types of sentences by the grammatical form of the question used to assess comprehension. While authors of reading comprehension tests are unlikely to use the more involved syntactical forms of question included in Bormuth's classification (Bormuth, 1970), they would do well to aim for syntactical simplicity in the form of question used to assess comprehension so that what is being tested is the child's understanding of a sentence or passage and not his ability or inability to understand the question in the first place.

CHAPTER V

SUMMARY, CONCLUSIONS AND IMPLICATIONS

This study was undertaken to identify the skills involved in reading comprehension, and thus to provide a basis for more fine-grained measurement of reading comprehension skills which might be useful in developing profiles of children's reading performance and in diagnosing deficiencies in skills which might be contributing to poor performance in reading. The investigation was concerned with language skills and selective reading skills; it was not concerned with perceptual skills such as visual discrimination since upper primary school children, who formed the subjects of the study, could largely be expected to have attained the levels of perceptual discrimination required in reading.

Several lines of development contributed to the form of the study. One was a long-standing controversy between Davis (1944, 1968) and other researchers as to whether logically different types of reading comprehension tests measured one broad general skill such as "reasoning in reading", or separate experimentally distinguishable comprehension skills. Another was the emergence of new types of reading comprehension test - cloze tests, chunked tests and multiple-choice tests in which each of the options had a defined relationship with the material in the passage for comprehension. A third factor was the increasing amount of information available about the linguistic development of children. Carroll's (1972) suggestion that it would be useful to have separate measures of "simple comprehension" and inferential comprehension was a fourth factor which strongly influenced the form of the study.

As the main thrust of the study was the identification of skills, it was designed in accordance with a factor analysis model. Tests were adapted or developed to provide measures of phonological-orthographic competence, of grammatical competence, of word and sentence order, of syntactic comprehension, of lexical competence, of reasoning and of speed of processing, which might help elucidate the skills involved in a wide range of reading comprehension tests - multiple choice, cloze, chunked, literal meaning, implied meaning, following printed instructions, selecting appropriate responses to simple one-sentence questions and statements, and speed of reading. The various reading comprehension tests were hypothesized to have substantial loadings on factors of phonological-orthographic competence, syntactic comprehension and vocabulary knowledge, and to have different levels of loadings on such factors as reasoning, knowledge of grammatical functions, punctuation and reading speed.

To counter the possibility that reported differences in the skills measured by different types of reading comprehension test might be a result of differing levels of linguistic complexity in the reading passages selected for the tests, the reading comprehension passages employed in the study were equated for length and linguistic complexity. The reading comprehension tests were also subject to two other controls. Except for tests C10 and C11, Comprehension of Explicit/Implicit Information, measures of literal meaning and implied meaning were not obtained from the same passages. Further, questions on the passages were not included in the test if they could be answered correctly by more than a small percentage of subjects who had not read the passages.

The test battery was applied to all Grade 6 children in six metropolitan Sydney schools in four full morning sessions spread generally over a period of four weeks. Three schools were selected from middle-class socio-economic areas and three from lower-class areas, a criterion for selection being that 90% or more of their Grade 6 children were native speakers of English. The battery yielded 42 variables which were factor analyzed separately for four groups of 166 boys and 173 girls from middle class socio-economic areas, and for 155 boys and 130 girls from lower class socio-economic areas. Maximum-likelihood and principal-factor methods of factor analysis were applied to the data, together with varimax and some direct oblimin rotations.

A. MAJOR CONCLUSIONS

The major conclusions to be drawn from the study can be considered within the framework of the three main questions to which it was addressed.

1. What are the components of reading comprehension?

Six factors were identified from the correlations among the forty-two variables. Five of the factors, viz. Knowledge of Word Meanings, Semantic Context, Reasoning, Punctuation and Perceptual Speed were identified separately for middle class boys, middle class girls, lower class boys and lower class girls, while the other factor, described as Sentence Comprehension, was identified for three of the groups but not for lower class boys. Separate factor analyses confined to the correlations among the 15 reading comprehension tests, including two speed of reading tests, yielded a Semantic Context factor for all groups, a Sentence Comprehension factor for three groups, a Speed of Reading factor for three groups, and a "logically-derived-question comprehension factor" for the two lower class groups.

Knowledge of Word Meanings is, understandably, an important component of reading comprehension, all of the fifteen reading comprehension tests being represented in this factor. Tests of phonological-orthographic competence are subsumed within this factor. Analyses of the degree of mastery attained by the children on the phonological-orthographic tests show that the skill of connecting printed word symbols with their corresponding sounds is generally well established among Grade 6 children from middle class areas; though they are less well established among Grade 6 children in lower class areas, it is apparent from the factor identifications that the proportion of children who are both proficient in phonological-orthographic skills and deficient in their knowledge of word meanings is small.

Knowledge of punctuation conventions does not appear to be a skill of any importance in reading comprehension. Perceptual Speed, the skill of locating verbal symbols quickly, is of some importance in speeded reading tests, but not in unspeeded tests of reading comprehension.

At first sight, the absence of significant loadings for the reading comprehension tests on the Reasoning factor would suggest that reasoning is not an important component of reading comprehension. This evidence, however, might be more correctly interpreted as indicating that the kind of reasoning involved in the designated reasoning tests is not the kind of reasoning called for in reading comprehension tests. The Reasoning factor was defined by the non-verbal Progressive Matrices 1938 test, which involved inductive reasoning with diagrammatic material, and by the verbal intelligence test, requiring the solution of multiple-choice items relating to word meanings, verbal analogies, logical and arithmetical reasoning, number series and the like. Two other tests of reasoning included in the battery were not represented on the Reasoning factor; Letter Grouping was a test of inductive reasoning, requiring the child to select one of four sets of four letters which was different from the other sets, and Thurstone Reasoning was a test of deductive reasoning of the form,

M is younger than N, K is older than N, therefore K is .... than M.

The specific types of reasoning involved in all of these tests would probably be rarely encountered in passages for reading comprehension. If reading is reasoning, as R.L. Thorndike (1973a) suggests, it is not this kind of reasoning.

What kind of reasoning might then be involved in reading comprehension tests? The other two components of reading comprehension identified in this study, viz. Sentence Comprehension and Semantic Context, throw some light on this question. The Sentence Comprehension factor was largely confined to tests requiring the interpretation of single sentences e.g.

(a) When did Tom come here?

(A) By taxi (B) Yes, he did (C) To study history (D) Last night

(b) John dropped the letter in the postbox.

(A) John sent the letter

(B) John opened the letter

(C) John lost the letter

(D) John destroyed the letter

(c) Write the name of your school and then your class

(d) Draw a circle around each of the letters in the list except for the letters A and F.

E T 5 3 6 A 4 F 6 2 A 9 4 X

These tests call for the understanding of a simple message, in a very limited context in the case of questions (c) and (d), though in a somewhat wider context in the case of questions (a) and (b), since the child is likely to be reading meaning into the actions described. In the case of the passage-type reading comprehension tests (Basic Skills Literal and Implied Meaning; Multiple-Choice, Cloze and Chunked Reading; Explicit and Implicit Information; Reading to Note Details and Reading for Inference), most of which define the Semantic Context factor, this search for meaning or search for wider context would be of a more extensive kind, in that the child is required to elicit meaning, to work out relationships and to weigh evidence, not only within separate sentences but among the sentences and the ideas expressed in the full passage. He has in effect to grasp the meaning or sense of the passage as a whole. The process in retrospect turns out to have been well described by E.L. Thorndike in his 1917 quotation, in which reading was said to be

> "a very elaborate procedure, involving a weighing of each of many elements in a sentence, their organization in the proper relations one to another......" etc.*

If the word "passage" were substituted for the word "sentence", this quotation would provide an adequate description of the Semantic Context factor. This weighing of elements and organization of parts of the passage in proper relation to one another, in which the reader is actively searching for meaning on the basis of a variety of language cues (cf. Goodman, 1966), seems then to represent the form of thinking or reasoning involved in reading comprehension tests. This component of reading comprehension has nevertheless been called a Semantic Context factor; it clearly relates to the apprehension of the meaning of sentences and passages in their wider context, and it differs from the usual narrower type of "Reasoning" factor. On the other hand, it is too broad to be described as a paragraph comprehension factor, since it is likely to be involved in the comprehension of single sentences and longer passages as well as paragraphs.

* See page 5.

In summary, the experimentally identifiable components of reading comprehension are Knowledge of Word Meanings, Sentence Comprehension, and apprehension of Semantic Context. The study provided rather less conclusive evidence that speed of reading and comprehension based on logically-derived questions might also be components of reading comprehension. Syntactical and grammatical skills did not prove to be experimentally identifiable components of reading comprehension. The fact that these and other hypothesized skills did not emerge as separate components suggests that their influence in comprehension is overshadowed by the strength of the reader's search for acceptable meaning.

2. What skills are being measured by different types of reading comprehension test?

The results presented in Table 4.9, based on the factor analyses of forty-two variables, provide answers to this question. Tests were not considered to be represented on a factor unless significant loadings occurred in more than one of the class x sex groups. The lack of representation of the Cloze test on the Semantic Context factor was regarded as being counterbalanced by the representation of the Speeded Cloze test on that factor, and the partial representation of the Basic Skills Implied Meaning and the Reading for Inference tests on the Sentence Comprehension factor were taken as anomalous. Given these interpretations, the reading comprehension tests can be classified into four groups according to the skills measured, with the typical strength and generality of the skill being indicated by + or ++

	Tests	Skills Measured
Group 1.	Basic Skills Literal Meaning Basic Skills Implied Meaning Multiple Choice Reading Comprehension Cloze Reading Comprehension Chunked Reading Comprehension Explicit Information Reading Comprehension Implicit Information Reading Comprehension Reading to Note Details Reading for Inference	Knowledge of Word Meanings (++) Semantic Context (++)
Group 2.	Comprehension of Questions Comprehension of Statements	Knowledge of Word Meanings (++) Semantic Context (++) Sentence Comprehension (++)

Group 3.	Following Instructions A Following Instructions B	Knowledge of Word Meanings (+) Semantic Context (+) Sentence Comprehension (+) Reasoning Perceptual (Processing?) Speed (B only).
Group 4.	Speeded Cloze Reading Comprehension Chapman Cook Speed of Reading	Knowledge of Word Meanings (++) Semantic Context (+) Perceptual Speed (Speed of Reading?)(+)

This classification of types of reading comprehension test is generally confirmed by the factor analyses based on the fifteen reading comprehension variables, with the possibility that the tests of Explicit and Implicit Information might be separated out as an additional grouping, measuring knowledge of word meanings, semantic context, and the skill of extracting meaning from a passage in response to standard forms of logically derived questions.

An important feature of this experimentally-identified classification of reading comprehension tests is that all unspeeded passage-type tests of reading comprehension measure the same skills-knowledge of word meanings, and apprehension of semantic context. Differences which were anticipated between tests of literal and implied meaning, and between cloze and multiple-choice tests did not emerge.

The lack of differentiation between tests of literal meaning and tests of implied or inferential meaning was not entirely unexpected. In the discussion of relevant research findings on page 18, it was pointed out that the proposed distinction had not been consistently supported. Evidence for the distinction had come from Feder (1938) and Davis (1944, 1968), but had been lacking or unclear in other studies (Derrick, 1953; Clark, 1973) and re-analyses (Thurstone, 1946; Thorndike, 1971, 1973b; Spearritt, 1972). Two clearly distinguishable factors obtained in a more recent study of 533 Grade 6 children in mid-western U.S.A. (Pettit and Cockriel, 1974) led the authors to conclude that literal reading comprehension and inferential reading comprehension are separately distinguishable dimensions in reading. Their results, however, may be largely due to the fact that they failed to take account of the need to pre-test their items without the passages, and to base their different measures on different passages; the six sub-scales of their Literal Reading Comprehension test were based largely on the same set of 18 passages, and the five sub-scales of their Inferential Reading Comprehension test on a further set of 14 passages. This in itself would be expected to yield higher intercorrelations within the sub-scales of each test than across the sub-scales of the two tests. Thus, the results of the Pettit and Cockriel study are hardly sufficient to offset the general finding that there is little firm evidence that reading comprehension tests of literal meaning and of implied or inferential meaning measure different skills.

The present study supports the conclusion reached in most previous research studies (see page 19) that the cloze type test measures the same skills as the multiple choice form of reading comprehension test.

3. Is it practicable to measure comprehension without inference?

This question was investigated by an examination of the loadings of syntactic, comprehension and reasoning tests on the Reasoning factor and also the Semantic Context factor, since the latter appeared to provide a better representation of the type of reasoning required in the comprehension of passages than did the former. The patterns of factor loadings indicated that it is possible to assess comprehension without at the same time assessing a person's inferential abilities, and that tests such as Comprehension of Sentence Structures and Following Instructions A would be suitable measures to use for this purpose. The former test has questions of this kind:

The cattle were taken to the water to drink.
Question: Why were the cows taken to the water?
Answer: ______________________________

Questions in the Following Instructions A test are of such types as:

Write the name of your school and then your class.
Draw a line under the fifth, second and fourth numbers in this list:
5 6 3 6 9 0 6 8 5 3

B. MINOR CONCLUSIONS

Analyses of tests of language skills which children might have been expected to have mastered at the point of completing their primary schooling indicated that the skill of comprehending simple printed instructions had been mastered by Grade 6 children from both middle class and lower class socio-economic areas. Skills involved in selecting an appropriate form of response to a question and in connecting the spoken word and its printed counterpart had been mastered by children from middle class areas, but were less well mastered by those from lower class areas. Rather lower percentages of both middle class (65% to 50%) and lower class children (40%) had mastered the skills required to select a paraphrase of a stimulus statement, or to extract the simple information given in basic sentence structures or in two sentences linked by pronouns or repetitive words or phrases. The score distributions for the tests used to investigate levels of mastery showed that the poorer performance of the lower class groups applied over the total score range and was not merely reflecting low scoring levels of a small number of children.

The study demonstrated that the commonly found superiority in reading and vocabulary tests of girls to boys and of children from middle-class areas to children of lower-class areas, extended to virtually the whole range of language tests considered. Considered as a whole, the results indicated that middle class girls tended to perform better than middle class boys who tended to perform better than lower class girls who tended to perform better than lower class boys. This applied to measures of phonological-orthographic competence, of grammatical and syntactic skills, and to most measures of reading comprehension. In some measures of vocabulary and reading comprehension, and also of reasoning, lower class boys attained slightly higher mean scores than lower class girls but the differences tended to be too small to be regarded as significant. Other reversals of the general trend occurred in the Punctuation tests, where both middle class and lower class girls obtained higher mean scores than middle class boys; in the vocabulary tests and particularly in the picture vocabulary test, where boys gained higher mean scores than girls in each of the middle and lower class groups; and in tests of perceptual speed, where the mean scores for girls exceeded the mean scores for boys in each of the two class groups.

Subsidiary studies on a reduced sample of cases of the comparative difficulty of different syntactic forms of sentences showed that sentences with left-branching or centre-embedded or right-branching clauses were of the same level of comprehensibility for these sixth grade children. They also provided evidence that the estimate of a child's level of comprehension of a statement may be influenced by the grammatical or syntactic form of the question used to assess his comprehension.

C. IMPLICATIONS

Experimental studies of the skills involved in reading comprehension are likely to identify somewhat different sets of skills for children of different age levels and with differing levels of experience in reading. At the age of 5 or 6, when children are learning to read, proficiency in making phonological-orthographic connections may be a prime determinant of their comprehension of printed material, and may well emerge as a separate skill. By the age of 11 or 12, phonological-orthographic competence could be well-established among most children, and may thus not emerge as an identifiable skill on which children vary in performance to any appreciable extent. Even if the same skill continues to be experimentally identifiable at widely different age levels, there may be substantial differences in the manner of its testing; vocabulary, for instance, would be tested with much more precision at older age levels (MacGinitie, 1973). The components of reading comprehension identified at any one age level may therefore not be too readily generalizable below or above that age level. Children in the upper primary school, however, can mostly be expected to have mastered the mechanics of reading and to have attained some facility in reading with comprehension, so that the results of the present study might reasonably be taken to apply to children in the upper primary school (Grades 5 and 6) and in the early years of secondary school.

The implications of the study relate mostly to the measurement of reading comprehension, but extend also to other aspects of reading.

1. Implications for Testing Programmes in Reading Comprehension

The study has shown that for Grade 6 children, reading comprehension tests mostly measure up to three experimentally distinguishable skills - knowledge of word meanings, appreciation of semantic context and sentence comprehension. In general, these tests do not involve the kind of reasoning skills required in verbal or non-verbal tests of intelligence, nor do they involve separately identifiable syntactic or phonological skills. Speeded tests of reading comprehension measure an additional speed of reading factor. An adequate profile of a child's skills in reading comprehension would therefore be provided by a test of vocabulary, a test of sentence comprehension, a passage-type test of reading comprehension, and a test of speed of reading. It was shown, however, that reading comprehension tests could be more finely differentiated, and that four broad groups of reading comprehension test could be distinguished. It was also found that some of the tests included in the study could be regarded as measures of simple comprehension which did not call for inferential thinking on the part of the child.

By drawing together these various lines of evidence, a full profile of the skills of upper primary school children in reading comprehension could be obtained from a battery of tests of the following type:

A. A test of vocabulary knowledge.

B. A test of simple comprehension, which might take one of two forms:

(i) A test requiring the understanding of simple instructions
e.g. Write your name with your last name first and then
your other names,

or (ii) A test of comprehension of sentence structures
e.g. If we don't hurry, we will miss the bus.
Question: What will happen if we don't hurry.
Answer: ______________________________

C. A test requiring the understanding of simple one-sentence questions or paraphrased statements

e.g. (i) When did Tom come here?
A. By taxi
B. Yes, he did
C. To study history
D. Last night

or (ii) John dropped the letter in the postbox.
A. John sent the letter
B. John opened the letter
C. John lost the letter
D. John destroyed the letter.

D. A test requiring the understanding of material presented in passages, without distinction as to whether the tests are of the multiple-choice, cloze or chunked form.

E. A test of speed of reading requiring the understanding of material presented in passages.

If more substantial evidence became available for a further differentiation of tests in the Type D category according to whether the suggested answers merely agree with, contradict, or are irrelevant to the material presented in the passages, or whether they require a greater degree of interpretation of shades of meaning, the profile might be extended by applying a suitable additional passage-type reading comprehension test where the questions are developed in accordance with the principles set down by Schlesinger and Weiser (1970) (see page 43).

A profile chart based on these five types of tests would pinpoint the areas of strength and weakness in a child's performance on reading comprehension, and thus provide diagnostic information about those aspects of his performance to which remedial instruction might be appropriately directed. This may be in the areas of sound-symbol correspondence, the expansion of vocabulary, the extraction of the underlying meaning of simple sentences or the interpretation of longer passages. It appears, however, from the examination of diagnostic procedures outlined in Chapter 4, that adequate diagnostic information for general screening purposes is obtainable from a reduced battery of tests e.g. a passage-type test of reading comprehension, a test of sentence comprehension, and either a vocabulary test or a test of phonological-orthographic competence. This could be expected to establish the general nature of a child's difficulties in reading with comprehension; clinical follow-up with finer instruments such as the Illinois Test of Psycholinguistic Abilities (Kirk et al, 1961) would be necessary in some cases.

2. Implications for Test Construction Procedures

Although they did not arise as implications of the study two of the procedures employed in this investigation seem to be worthy of general adoption by persons constructing tests of reading comprehension. One procedure requires that the proposed test questions be first applied to children who have not read the passages, so that questions which can be answered correctly by a substantial proportion of these children can be excluded from the final form of the test. The other procedure relates to circumstances in which separate measures of pupil performance are sought in vocabulary in context, reading for literal meaning, reading for implied meaning and the like. To avoid contamination of one measure by another, each of such measures should be based on a different set of passages.

One finding of significance for test construction procedures was that the estimate of a child's degree of comprehension of a statement varied according to the grammatical form of the question used to assess his comprehension. Questions in rote form were easier than other types of question, but as Anderson (1972) points out, correct answers to such questions can be obtained from surface features of the statement and are not necessarily to be taken as evidence of comprehension. On the other hand, transform questions such as "By whom was dinner being cooked" in response to the statement "They were talking while she cooked dinner", could well confuse a number of children who knew perfectly well who was cooking the dinner. The framing of questions in terms of paraphrased but not transformed statements would appear to be a satisfactory method of ensuring that it was the child's understanding of a sentence or passage which was being assessed and not his ability to understand the question. Bormuth's approach to the testing of comprehension may well provide useful information about the child's ability to cope with syntactic complexity, but may underestimate his actual degree of comprehension.

Although there was insufficient evidence to mark out the Explicit Information and Implicit Information tests from other types of reading comprehension test, the factor composition of these tests among the children from lower class areas suggests that further experimentation with the test construction procedures proposed by Schlesinger and Weiser (1970) would be worthwhile. In effect, the test constructor would need to develop three options for each question - one which agreed with the information given in the passage, one which contradicted it, and one for which the information in the passage had no relevance.

3. Implications for the Teaching of Reading

The results of the study suggest that teaching could profitably be directed to the expansion of vocabulary, to discussion of the ways in which sentences within a paragraph relate to each other in building up the total meaning, and for the weaker pupils, to interpretation of the meaning of single sentences. But the results do not suggest that further attention to the development of phonological-orthographic skills, grammatical understanding and syntactic skills is unnecessary. Although particular skills may not be identified as separate factors, they may nevertheless contribute to a child's overall performance in reading comprehension and may usefully form part of the teaching designed to improve his level of comprehension (cf. Berg, 1973), especially with children deficient in such skills.

What implications for teaching arise from the facts that boys tend to achieve lower mean scores than girls, and children from lower class socio-economic areas tend to do less well than children from middle class areas, in almost all of the language variables examined in the study? The differences may be partly accounted for, though not explained by, the differences in the intelligence levels of the various groups. They may also reflect general differences among the groups in motivation and attitude to schooling, though it should be noted that boys obtained higher mean scores than girls on the picture vocabulary test, and the lower class groups obtained higher mean scores than the middle class groups on one of the perceptual speed tests. The fact remains that the general pattern of language test differences favours girls over boys and middle-class over lower-class children. The prima facie and perhaps simplistic implication for the teaching of reading would seem to be that boys need more instruction than girls in reading skills, and lower-class children more instruction than middle-class children, to attain the same levels of performance. Whether such action would achieve the desired result or be negated by attitudinal or motivational factors would form an interesting hypothesis for experimentation.

4. Implications for a definition of reading comprehension

The dependence of a child's level of reading comprehension on his knowledge of word meanings is clearly confirmed in the study. But the identification of the two separate factors of Reasoning and appreciation of Semantic Context suggests that if "reading is reasoning" (Thorndike, 1973a) it involves a somewhat different kind of reasoning to that measured by standard kinds of verbal and non-verbal intelligence test, though it may bear a closer resemblance to the verbal reasoning scores derived from verbal sections of scholastic aptitude tests comprised largely of questions on passages for reading comprehension. The question of just what kind of reasoning is involved in reading comprehension tests is not answered by the study, but E.L. Thorndike's 1917 description of the process as involving a weighing of elements, their organization in the proper relations, and the selection and rejection of various connotations would still seem appropriate. A detailed comparison of the thinking processes employed by children in answering intelligence test items and in answering questions based on passages in reading comprehension tests should throw more light on the nature of reading comprehension.

APPENDIX A

SOURCES OF TESTS AND DETAILS OF TEST CONSTRUCTION

1. Test P1. Word Sounds (Sound to Symbol Recognition)

Source: Original items developed for a commonly used type of test. Items were developed from groups of three words which were phonetically the same except for one sound, e.g.

Initial consonant contrasts: taught, thought, sought
Middle consonant contrasts: decision, derision, division
Ending consonant contrasts: sand, sank, sang
Vowel contrasts: calf, cuff, cough.

This form of test was preferred to a symbol to sound recognition version, as the latter would involve either greater memory load or true-false format for item response.

Number of items: Initial form: 54; final form: 30.
Items answered correctly by all or nearly all trial subjects were eliminated from final form.

2. Test P2. Finding Rhymes

Source: Part 3, Modern Language Aptitude Test, Elementary Form (Carroll and Sapon, 1960).

Number of items: Initial form: 45; final form: 44.
One item inappropriate for Australian children.

3. Test P3. Hidden Words

Source: Part 1, Modern Language Aptitude Test, Elementary Form (Carroll and Sapon, 1960).

Number of items: Initial form: 30; final form: 29.
One item inappropriate for Australian children.

4. Test P4. Word Attack

Source: Original. Based on Venezky's comment (1967) that a good reader is a person who can pronounce correctly not only the words he has been taught to read, but also a high percentage of words he has not encountered previously. Stimulus words consist of syllabic words unlikely to be known by Grade 6 children, about half being drawn from specialized vocabularies.

The initial 28 words together with an intermingled 16 syllabic words with which pupils were likely to be acquainted were applied by research assistants in printed and then in spoken (live) form to three classes of Grade 6 children, and in spoken (live) followed by printed form to two other classes of Grade 6 children. The children were asked to indicate the words they had seen or heard previously. The nine items excluded from the initial form comprised words for which one-sixth or more of the children claimed familiarity with the spoken or written form of the word or both, and words which failed to discriminate between upper and lower groups as defined by the total score on the 28 items. Monosyllabic words and difficult syllabic words in common use were considered unsuitable as stimulus words, as skills other than those to be assessed could contribute to their recognition.

Number of items: Initial form: 28; final form: 19.

5. Test G1. Word Uses

Source: Form 2A of a test developed by Carroll (1971a)for a study on multiple grammatical functions, checked for suitability for Grade 6 children in Australia. Two-thirds of the words were drawn from high and low frequency noun and verb usages and one-third from anomalous usages.

Number of items: Initial form: 21; final form: 21.

6. Test G2. Linguistic Markers

Source: Original. Based on a suggestion made by Carroll (1969) with the example "She was a ruvijam, but he was only a jilikum." Appropriate types of sentences were selected from Menzel's classification (Bormuth, 1970) and other sources.

Number of items: Initial form: 20; final form: 20.

7.8. Tests G3, G4. Punctuation A, B.

Source: Two passages prepared for previous studies by author with Grade 6 children.

Number of items: No. of punctuation marks for Passage A: 24.
No. of punctuation marks for Passage B: 28.

9. Test G5. Scrambled Sentences

Source: Original. Sentence types listed in Menzel's classification (Bormuth, 1970) were used as a basis for developing fifty sentences which were then put into scrambled form.

Number of items: Initial form: 50; final form: 18.
In selecting sentences for inclusion in the final form of the test, preference was given to sentences of appropriate discrimination and difficulty levels which could be rewitten correctly in only one or two ways.

10. Test G6. Combining Sentences

Source: Part 3, Combining Sentences, from An Experimental Test of English as a Foreign Language (Educational Testing Service, 1971), with minor wording alterations and two replacement items.

Number of items: Initial form: 21; final form: 18.

11. Test G7. Comprehension of Sentence Structures

Source: Eighteen sentence types were selected from those listed in the transformational analysis section of Menzel's classification (Bormuth, 1970), after excluding those considered to be too easy for Grade 6 children or not readily amenable to the framing of comprehension questions. In the trial testing with Australian children, four types of question (Bormuth et al, 1970) were asked for each of the eighteen stimulus sentence types. For example, sentences representing the Subordinate Sentences - Purpose category, and their associated questions, were as follow:

Sentence A: The man came to fix the pipes.
Rote question: Why did the man come?
Sentence B: Andy bought a paper to read about the football game.
Transform question: Why was the paper bought by Andy?
Sentence C: The cattle were taken to the water to drink.
Semantic substitute question: Why were the cows taken to the water?
Sentence D: The children went to the zoo to see the animals.
Compound question: Why was the zoo being visited by the children?

Four of the sentence-types which were answered correctly by almost all children in each of the four question forms were eliminated. The remaining sentence-types and question forms based on them were spread throughout the test.

Number of items: Initial form: 18x4 = 72 items
Final form: 14x4 = 56 items.

12. Test G8. Comprehension of Anaphoric Expressions

Sentences were prepared in each of the four question forms (Rote, Transform, Semantic Substitute and Compound) for fifteen sentence types, and in rote form only for four other sentence-types. The use of the personal pronoun anaphora structure is shown in the following sentences and their associated questions:

Sentence A: Peter hit the ball. He was a good player.
Rote question: Who was a good player?
Sentence B: Mary was hungry. She bought two cakes.
Transform question: By whom were the cakes bought?
Sentence C: The letter was written by Peter. He was staying in Melbourne.
Semantic substitute question: Who was visiting Melbourne?
Sentence D: The cattle were scattered about the field. They were eating the hay.
Compound question: By what was the crop being eaten?

Four of the anaphora sentence-types which were answered correctly by almost all children in each of the four question forms were eliminated, and the remaining sentence-types and question forms were distributed throughout the test.

Number of items: Initial form: (15x4) + (4x1) = 64.
Final form: (11x4) + (4x1) = 48.

13. **Test G9. Embedded Sentences**

Source: Fifty-three sentences covering a wide range of types of clauses were selected from books of appropriate interest level for Grade 6 children, and each sentence was presented in a left-branching, centre-embedding and right-branching form, one sentence from each form being assigned at random to one of three versions of the trial test. Only one of the three versions of the trial test was applied to any one child. Data from the 159 questions were used to eliminate 33 sentences which were very easy for the children in each of the three embedded forms and to select the most difficult embedded form among each of the remaining 20 sentences in order to develop a test with maximum discriminating power.

Number of items: Initial form: 53x3 = 159
Final form: 20, including 5 left-branching, 9 centre embedded and 6 right-branching items.

14. **Test G10. Recovery of Deep Structure**

Source: The test was based on an approach suggested by Simons (1971). Fifty-four sentences were developed to represent most of the sentence-types set out in the transformational analysis section of Menzel's classification (Bormuth, 1970). Application of the 54 sentences to 79 Grade 6 children in the response form only, and then in the paired stimulus and response form on the following day, provided data which allowed items to be rejected when more than one to five children could give the correct answer without the stimulus sentence, such as

He received a blow ______ ______ hammer, corresponding to "He received a hammer blow."

Number of items: Initial form: 54; final form: 30.

15. **Test G11. Ambiguous Sentences**

Source: Appropriate sentences were developed by MacKay (1966) and were subsequently used in picture forms by Kessel (1970). A set of 20 sentences was selected, using material from these two sources. The sentences comprised examples of both surface structure ambiguity and underlying structure ambiguity e.g.

He turned round the signpost. (Surface structure ambiguity involving a change in the way in which words are grouped into phrases).

They enjoyed watching the eating of the fish. (Underlying structure ambiguity, involving a change in the essential relations between words).

Four line drawings were prepared by an artist for each sentence, two of them representing different correct interpretations of the sentence, the other two representing pictorially related but incorrect interpretations. Credit was given for an item when the two correct interpretations were the only drawing selected.

Number of items: Initial form: 20; final form: 14, after elimination of very difficult items.

16. Test L1. Reading Vocabulary, no context.

Source: Adapted from Form A of A.C.E.R. Word Knowledge test.

Number of items: 30.

17. Test L2. English Picture Vocabulary Test

Source: The test is an adaptation of the Peabody Picture Vocabulary Test (Dunn, 1959) for group administration (Brimer and Dunn, 1962). Part 2 of the test, excluding the first eight easy items, proved to be of appropriate difficulty and discriminating power for Grade 6 children in Australia.

Number of items: Initial form: 40; final form: 32.

18. Test L3. Context Reading Vocabulary

Source: Adapted from New South Wales Basic Skills Reading Test R, Grade 6, Form Y. Three passages ranging between 200 and 400 words in length were selected at spaced intervals across the test and were used for testing vocabulary only.

Number of items: 24.

19, 20. Tests C1, C2. New South Wales Basic Skills Reading Test (Adapted)

Source: Sixty-nine questions drawn from 7 passages of Form X and 3 passages of Form Y were applied without the passages to 94 children in Grade 6. Despite the fact that the passages had not been presented to the children, 13 of the questions were answered correctly by at least 50 children, 23 by at least 40 children and 39 by at least 30 children.* Employing the criterion that questions should not be answered correctly under these circumstances at a greater than chance level, only 30 of the items were acceptable. These were further reduced in number in order to provide measures of literal meaning and implied meaning based on different passages.

Number of items: Initial form: 69; final form: 25, consisting of 14 questions on literal meaning drawn from 5 passages, and 11 questions on implied meaning drawn from 3 different passages.

21. Test C3. Multiple-Choice Reading Comprehension (Passage equated)

Source: "St. Nicholas" and "Flies" passages from Miller-Coleman Scale (Miller and Coleman, 1967).

Number of items: Initial form: 20; final form: 20.

22. Test C4. Cloze Reading Comprehension (Passage equated)

Source: "Jimmie Cod" passage from Miller-Coleman Scale.

Number of items: 30.

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* Although it was understood that the children had not taken the tests previously, it is possible that some had taken easier versions of the tests in earlier grades.

23. Test C5. Chunked Reading Comprehension (Passage equated)

Source: "Mount Everest" and "Camping" passages from Miller-Coleman Scale.

Number of items: Initial form: 21; final form: 21 (17 credited).

24. Test C6. Comprehension of Questions

Source: Part 1, Sentence Comprehension, from An Experimental Test of English as a Foreign Language (ETS, 1971).

Number of Items: Initial form: 12; final form: 18.

25. Test C7. Comprehension of Statements

Source: As for Test C6.

Number of items: Initial form: 18; final form: 18.

26, 27. Tests C8, C9. Following Printed Instructions

Source: Based on a suggestion by Carroll (1971b, 1972) that the type of item used in some of the early tests of mental ability, e.g. the U.S. Army Alpha test, would provide a valid measure of comprehension. Sixteen items of this type were developed with a parallel counterpart for each item. In preliminary testing, one form of the 16 item test was applied with oral instructions, and then the other form with printed instructions to three classes of Grade 6 children. As indicated in Chapter 3, eight easy item types were grouped into one sub-test, and eight more difficult item types into another. The 16 items in the final test comprised those used in the original written form of the test.

Number of items: Initial form: 8+8; final form: 8+8.

28, 29. Tests C10, C11. Comprehension of Explicit/Implicit Information

Source: The systematic approach advocated by Schlesinger and Weiser (1970) for the construction of items for a reading comprehension test concentrates on the relation of the item to the information presented in the passage rather than on skills and abilities supposedly involved in comprehending the passage. Distractor-statements are classified according to whether they are in agreement with, or contradict information explicitly given in the text, or whether the text contains no information relevant to the distractor-statement. This type of test item is likely to provide a purer measure of comprehension in that it avoids the shades of meaning often built into distractors in the usual multiple-choice item, which tend to induce judgment or evaluation or even reasoning about the relative merits of the distractors.

Items were constructed in the manner indicated above for three passages, each of approximately 450 words in length, which were suitable for Grade 6 children. Data from trial testings were used to eliminate items which could be answered correctly with greater than chance expectation in the absence of the passages, and items with insufficient discriminating power. The remaining items which related to information given explicitly in the three passages formed Test C10, and those relating to information given implicitly in the three passages formed Test C11.

Number of items: Initial form: 36; final form: 18, comprising 12 based on explicit information and 6 on implicit information.

30. Test C12. Reading to Note Details.

Source: Adapted from A.C.E.R. Reading to Note Details, Forms A and B. Items which could be answered correctly in the absence of the passages more frequently than approximate chance expectation were eliminated.

Number of items: Initial form: 18; final form: 12 items, based on 5 passages.

31. Test C13. Reading for Inference

Source: Adaptation of A.C.E.R. Reading for Inference, Form A. The passages range between 40 and 90 words in length.

Number of items: 12.

32. Test R1. Letter Grouping

Source: L.L. Thurstone. Included as a reference test for Induction in E.T.S. Kit of Selected Tests for Reference Aptitude and Achievement Factors (French, 1954, French et al., 1963).

Number of items: 30.

Time limit: 4 minutes.

33, 34, 35, 36. Tests R2, R3, R4, R5. Raven's Progressive Matrices, 1938.

Source: J.C. Raven, 1938

Number of items: 12 in each of Sets A, B, C, D, E. As Set A is very easy for children in Grade 6, scores were combined for Sets A and B, and separate scores obtained for Sets C, D and E.

37. Test R6. Reasoning

Source: L.L. Thurstone, 1952.

Number of items: 30.

Time limit: 5 minutes.

38. Test R7. Verbal Intelligence

Source: Assessed IQ's from A.C.E.R. TOLA 4 and Intermediate D tests.

Number of items: TOLA 4: 71; Intermediate D: 75.

39. Test S1. Speeded Cloze Reading Comprehension

Source: "Cherokee Indians" passage from Miller-Coleman Scale.

Number of items: 30.

Time limit: On the basis of trial data, a time limit of 4 minutes was set for the test proper as compared with 15 minutes for Test C4.

40. Test S2. Chapman-Cook Speed of Reading Test

Source: Test prepared by Chapman and Cook, published by Educational Test Bureau, 1924, as adapted for Australian children. (Spearritt, 1962).

Number of items: 30.

Time limit: 2½ minutes for test proper.

41. Test S3. First Digit Cancellation

Source: L.L. Thurstone

Number of items: 75.

Time limit: 3 minutes.

42. Test S4. Letter "A"

Source L.L. Thurstone

Number of items: 50 columns of 40 words x 4 words per column = 200.

Time limit: 2½ minutes.

APPENDIX B

ORDER OF ADMINISTRATION OF TESTS

Test No. Booklet	Report	Test Title*	Time Limit (mins.)	Total Time (mins.)
		FIRST DAY		
19(C3)	C4	C Test (Unspeeded cloze reading)	15	21
5(G3)	G1	Word Uses	6	8
10(G15)	G8	Sentences A (Comprehension of Anaphora)	25	30
2(P4)	P3	Hidden Words (M.L.A.T., Elementary)	5	10
3(P3)	P2	Finding Rhymes (M.L.A.T., Elementary)	6	10
		Morning Recess		
11(G17)	G9	Sentence Embedding	15	20
24(C21)	C12	Reading to Note Details (ACER, Adapted)	12	15
6(G6)	G2	Sentences LM (Linguistic Markers)	10	15
14(L1)	L1	Reading Vocabulary	6	10
		SECOND DAY		
17,18(C1)	C1,C2	N.S.W. Basic Skills Test R (Adapted)	35	45
7(G10)	G5	Scrambled Sentences	30	32
13(G20)	G11	Sentences AM (Ambiguous Sentences)	7	10
		Morning Recess		
25(C23)	C13	Reading for Inference (ACER, Adapted)	9	12
21(C7)	C6,C7	Sentence Comprehension (ETS, Adapted)	20	28
26(R1)	R1	Letter Grouping	4	20
33(S6)	S2	Chapman-Cook Speed of Reading	2½	8
		THIRD DAY		
23(C15/17)	C10, C11	Reading Comprehension (Explicit & Implicit Information)	30	33
12(G19)	G10	Sentence SD (Deep Structure)	22	25
22(C9)	C8,C9	Directions Test (Following Instructions)	10	11
4(P5)	P4	Word Attack (Tape recording)	-	12
1(P1)	P1	Word Sounds (Tape recording)	-	10
		Morning Recess		
31(R3)	R6	Reasoning (Thurstone)	5	13
8(G12)	G6	Combining Sentences (ETS, Adapted)	18	22
16(L4)	L3	Reading Vocabulary (NSW Basic Skills Test R, Adapted)	20	23
		FOURTH DAY		
20(C5)	C5	Chunked Reading	12	20
9(G13)	G7	Sentences S (Comprehension of Sentence Structures)	20	23
- -	C3	Reading Comprehension MC (Multiple Choice)	12	15
36(S2)	S1	Speeded C Test (Speeded cloze reading)	4	9
34,35(G21)	G3,G4	Open Punctuation	20	21
		Morning Recess		
15(L3)	L2	English Picture Vocabulary Test	-	10
37(S9)	S3	First Digit Cancellation Sd-2	3	7
38(S9)	S4	Letter A. Sd-1	2½	6
27-30(R2)	R2,R3, R4,R5	Progressive Matrices, 1938.	20	30

* The bracketed parts of these titles did not appear on the test booklets but are included here to assist interpretation.

APPENDIX C

RELIABILITY COEFFICIENTS OF TESTS

The reliability coefficients presented in this Appendix are based on a systematic sample of one in six, drawn with a random start from the final sample of 624 cases. Thus, the reliability sample included 104 cases, comprising 24 boys and 23 girls from schools in lower class socio-economic areas, and 27 boys and 30 girls from schools in middle-class areas.

Reliability coefficients were computed by means of Kuder-Richardson Formula 20 for those tests which were completed by all or almost all of the children within the time allowed. As the condition of item independence was unlikely to be achieved in the unspeeded cloze test, in that successive responses might be influenced by syntactical clues in the passage, the reliability of this test was determined by correlating scores on the first and second halves of the test, and applying the Spearman-Brown formula. Data were not available to determine the reliability coefficients of speeded tests within the present study, but coefficients obtained for some of these tests in other comparable studies have been included in the table.

RELIABILITY COEFFICIENTS
(Based on 104 cases, except
where specified otherwise)

Test	Type of coefficient	Value of coefficient	Raw Score Mean	S.D.	No. of items in test
P1 Word Sounds	KR20	.72	26.29	3.14	30
P2 Finding Rhymes	KR20	.93	37.07	7.82	44
P3 Hidden Words	KR20	.86	19.97	5.62	29
P4 Word Attack	KR20	.59	11.46	3.10	20
G1 Word Uses	KR20	.59	15.28	2.69	21
G2 Linguistic Markers	KR20	.88	12.69	4.91	20
G3 Punctuation A	r_{AB}	.84	12.73	5.87	24
G4 Punctuation B	r_{AB}	.84	11.22	7.13	28
G5 Scrambled Sentences	KR20	.85	10.09	4.42	18
G6 Combining Sentences	KR20	.79	9.65	4.07	18
G7 Compreh. of Sentence Structures	KR20	.94	46.50	9.70	56
G8 Compreh. of Anaphoric Expressions	KR20	.90	36.25	7.76	.48
G9 Embedded Sentences	KR20	.81	13.89	4.28	20
G10 Deep Structure	KR20	.89	18.86	6.31	30
G11 Ambiguous Sentences	Spearman-Brown formula applied to r between two subtests	.78	4.25	3.92	14
L1 Rdg.Vocab. no context	KR20	.87	20.70	5.93	30
L2 English Pict. Vocab.	KR20	.73	20.73	4.30	30
L3 Context Rdg. Vocab.	KR20	.78	13.72	4.58	24
C1 Basic Skills,Lit.Mng.	KR20	.72	9.23	2.94	14
C2 Basic Skills,Imp.Mng.	KR20	.75	5.65	2.90	11
C3 Mult.Choice Rdg.Comp.	KR20	.77	11.46	3.84	20
C4 Cloze Rdg.Comp.	Spearman-Brown formula applied to r 1st ½,2nd ½	.74	14.76	4.39	30
C5 Chunked Rdg.Comp.	KR20	.80	11.26	3.89	21
C6 Compreh. of Questions	KR20	.85	15.65	3.26	18
C7 Compreh. of Statements	KR20	.78	13.71	3.53	18
C8 Following Inst. A	KR20	.66	7.10	1.38	8
C9 Following Inst. B	KR20	.70	4.61	2.19	8
C10 Explicit Inf.Rdg.Comp.	KR20	.77	7.78	3.07	12
C11 Implicit Inf.Rdg.Comp.	KR20	.38	3.25	1.47	6
C12 Rdg. Note Details	KR20	.73	5.79	2.74	12
C13 Rdg. for Inference	KR20	.76	7.99	2.87	12
R1 Letter Grouping	Test-retest*	.89		9.16	30
R2 Prog. Matrices, A+B	KR20	.84	19.86	3.75	24
R3 Prog. Matrices, C	KR20	.67	7.25	2.26	12
R4 Prog. Matrices, D	KR20	.75	7.65	2.49	12
R5 Prog. Matrices, E	KR20	.66	3.33	2.24	12
R6 Thurstone Reasoning	KR20	.83	13.14	4.66	30
R7 Verbal Intelligence (Score derived from tests applied in Gr.4 and Gr.6)	KR20*	.95	-	-	-
S1 Speeded Cloze Rdg. Comp.	Not obtained				
S2 Chapman-Cook Spd. Rdg.	Test-retest*	.86		4.45	30
S3 First Digit Cancel.	Not obtained				
S4 Letter A	Not obtained				

* Based on Victorian Grade 6 children, the number of cases being 38 for Letter Grouping, 100 for Verbal Intelligence, and 30 for Chapman-Cook Speed of Reading.

APPENDIX D.1

Intercorrelations of 42 variables for 166 boys (Above Diagonal) and for 173 girls (Below Diagonal) in middle class socio-economic areas.

(Decimal points omitted)

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
1. Verbal Intell.(R7)		35	43	56	49	45	66	62	59	34	60	59	62	29	70	40	62	55	59	57	55	60	40	63	50	54	47	42	56	55	30	41	35	35	26	42	56	50	55	58	21	21
2. Word Sounds(P1)	46		17	35	26	31	47	38	39	15	31	34	34	15	30	24	40	36	37	22	19	23	17	30	30	27	26	22	41	31	15	16	10	09	06	13	36	23	19	34	09	19
3. Hidden Words(P3)	54	27		36	37	32	34	35	27	33	28	30	43	17	47	26	39	30	30	20	38	43	24	32	31	25	36	29	36	33	52	11	17	17	06	33	46	30	20	45	39	20
4. Find Rhymes(P2)	64	40	47		33	37	33	49	41	29	43	51	50	16	56	28	46	42	44	34	40	40	45	45	35	41	33	32	43	35	12	13	21	21	02	23	45	50	47	49	11	19
5. Word Attack(P4)	41	35	40	35		26	44	44	41	33	30	37	49	24	51	27	38	33	39	36	30	38	31	35	35	43	31	28	47	34	34	13	13	16	02	28	33	38	46	40	19	13
6. Word Uses(G1)	28	14	31	13	31		41	35	33	26	28	35	40	21	37	29	33	29	27	36	31	34	20	34	21	23	24	21	31	26	20	10	09	09	-01	18	32	27	24	27	15	06
7. Ling Markers(G3)	64	43	49	52	35	29		61	64	65	59	67	64	29	65	24	62	61	61	60	48	50	56	65	51	42	46	44	59	59	24	34	36	23	19	25	55	56	48	54	12	22
8. Scrambled Sent(G5)	63	46	40	55	46	27	61		51	41	51	50	59	24	62	60	61	55	58	53	47	56	45	50	38	47	44	41	48	52	29	22	23	36	14	35	48	47	44	40	17	26
9. Combining Sent(G6)	57	49	30	44	29	16	56	51		42	45	53	59	30	50	44	63	52	56	57	51	51	51	69	48	54	44	34	53	60	16	25	30	30	20	32	41	42	41	44	17	12
10. Comp.Sen.Struc(G7)	34	33	34	30	25	26	31	26	31		31	41	48	16	42	28	43	39	35	39	30	41	36	43	39	33	41	34	39	41	21	07	23	24	08	32	43	30	31	39	16	17
11. Anaphora(G8)	64	52	40	56	31	35	59	62	50	39		56	55	27	56	36	50	49	48	52	48	53	40	53	39	38	43	44	51	51	17	33	24	21	18	23	47	44	44	51	19	24
12. Embedded Sent.(G9)	57	39	37	49	30	20	59	59	41	16	56		61	31	64	41	61	55	53	49	43	54	44	55	42	43	38	38	56	44	21	22	30	32	17	27	44	51	48	55	13	22
13. Deep Structure(G10)	70	46	43	60	40	35	63	74	57	36	65	57		24	67	47	66	49	58	50	57	63	52	68	53	59	51	42	61	51	33	25	30	37	18	41	53	57	48	55	21	29
14. Ambiguous Sent(G11)	39	33	20	34	30	14	31	33	33	17	41	31	47		26	25	26	25	29	33	23	23	28	35	14	19	20	17	14	31	08	08	14	19	12	00	21	23	25	23	15	13
15. Voc.no con. (L1)	69	49	55	53	41	33	59	58	52	44	58	52	60	37		47	64	57	60	50	49	60	47	57	48	53	56	48	67	58	30	26	30	33	14	32	55	50	50	62	25	22
16. Eng.Pic.Voc.(L2)	62	33	44	48	34	24	51	52	46	30	48	47	55	25	65		52	32	41	42	35	48	30	43	35	37	35	34	43	48	14	12	10	24	22	33	40	29	30	51	12	04
17. Voc. in con.(L3)	67	41	52	51	42	32	61	56	53	40	55	52	63	33	67	61		50	54	49	48	55	48	59	37	50	48	40	51	56	19	28	36	41	19	40	54	53	54	59	24	26
18. Sen.Sh.Lit.Adg(C1)	62	46	36	53	30	24	63	60	61	23	57	55	64	38	64	56	57		58	55	44	50	42	55	48	39	54	49	57	55	14	29	21	22	21	24	37	31	34	46	11	03
19. Sen.Sh.Imp.Adg(C2)	57	38	36	39	34	33	58	48	50	33	51	39	51	26	62	46	50	56		50	37	51	49	64	51	52	57	54	57	60	19	17	29	21	28	26	40	32	34	49	11	18
20. Mult.Ch.Adg.(C3)	51	45	37	41	29	19	46	46	51	19	44	48	50	29	53	45	48	54	50		42	58	43	58	38	45	45	49	48	55	16	19	25	32	23	23	38	42	48	43	08	17
21. Close Adg(C4)	58	27	38	51	33	37	45	50	37	23	52	52	54	32	59	58	50	50	49	42		51	43	51	34	46	35	29	39	48	23	35	27	33	12	18	38	40	39	44	28	17
22. Chunked Adg(C5)	61	40	34	42	30	27	58	54	52	38	60	50	59	37	55	46	51	55	50	57	47		49	61	40	49	67	47	54	55	29	33	25	29	12	35	54	49	49	55	31	32
23. Comp.Ques.(C6)	40	37	38	38	32	26	47	48	41	22	35	40	51	13	47	29	42	46	45	42	43	37		67	44	43	38	40	43	55	09	14	26	19	15	12	46	44	43	40	12	17
24. Comp.Statements(C7)	54	44	32	50	39	24	53	54	50	31	50	44	60	32	53	46	53	50	51	41	49	50	52		46	56	56	57	57	67	14	30	28	25	20	33	46	43	47	48	16	13
25. Foll.Inst.A(C8)	33	24	23	26	07	19	33	26	31	05	25	33	39	16	27	22	19	39	13	24	15	26	38	27		51	34	36	30	37	20	23	24	24	05	24	32	33	28	28	16	05
26. Foll.Inst.B(C9)	63	38	41	49	26	21	50	58	49	20	52	59	62	31	51	48	46	52	41	44	46	56	45	46	42		36	30	43	44	20	32	31	38	26	37	30	34	39	38	27	26
27. Com Expl.Inf.(C10)	56	40	31	44	31	19	58	51	53	28	54	48	54	34	61	54	59	61	63	49	48	54	44	59	26	47		57	59	58	16	14	13	15	11	26	38	28	36	46	-02	14
28. Comp.Imp.Inf.(C11)	52	29	31	32	32	16	42	38	40	28	46	37	42	26	51	38	46	51	43	36	36	44	32	45	23	30	52		50	49	21	13	16	13	18	28	36	25	30	37	17	12
29. Adg.Note Det(C12)	62	39	50	49	34	33	61	49	43	27	54	47	59	34	65	57	57	55	55	45	50	50	48	48	30	49	51	43		58	18	20	22	20	22	31	49	43	47	53	10	16
30. Adg. for Inf(C13)	58	47	46	44	33	30	54	49	47	34	53	46	49	24	57	44	58	56	61	49	44	51	53	60	20	48	55	36	53		09	17	18	18	10	25	56	31	38	50	13	15
31. Letter Grp(R1)	35	17	29	28	35	04	25	38	23	15	22	18	34	09	33	25	27	35	15	24	15	21	20	18	14	28	15	16	15	25		06	12	10	09	45	30	18	17	23	34	34
32. Prog.Mat A,B(R2)	45	29	17	35	11	03	38	42	38	10	31	37	42	25	28	32	35	43	29	30	35	31	26	29	23	38	32	23	23	28	24		34	35	31	04	07	19	19	23	13	01
33. Prog.Mat.C(R3)	36	12	16	19	13	19	25	28	33	11	23	28	35	33	23	19	27	34	21	20	33	24	19	24	12	24	25	27	21	15	25	43		42	33	22	16	31	34	23	24	14
34. Prog. Mat.D(R4)	46	21	08	31	13	10	39	40	55	18	33	38	44	19	35	39	32	48	33	42	29	43	27	42	29	42	43	42	33	27	24	39	38		18	15	14	25	25	20	15	19
35. Prog.Mat.E(R5)	44	25	18	28	16	18	34	36	37	25	29	32	40	24	33	25	31	40	30	27	27	40	32	31	30	38	32	16	35	36	27	37	28	31		17	-04	16	28	04	16	12
36. Th.Reasoning(R6)	43	21	34	31	21	07	33	28	33	37	32	37	34	09	40	37	35	35	37	23	36	38	13	25	09	30	36	38	24	29	24	15	19	25	20		37	25	36	35	28	34
37. C-C Spd.Adg(S2)	51	36	39	48	36	27	47	44	33	36	56	43	55	25	59	50	55	41	52	43	43	43	30	45	13	38	46	36	45	47	30	18	13	20	19	41		45	44	65	21	27
38. Punctuation A(O3)	61	44	38	63	28	17	49	60	47	21	53	48	63	26	51	45	51	46	35	38	33	44	40	43	30	47	43	30	46	42	30	27	16	29	38	26	41		73	49	16	23
39. Punctuation B(O4)	60	39	35	55	33	22	48	49	36	32	51	43	56	26	47	34	46	40	31	37	36	35	37	42	22	38	36	34	43	39	35	23	28	27	37	28	38	74		53	13	19
40. Speeded Cloze(S1)	58	37	45	41	33	41	43	45	28	23	54	42	49	20	54	49	48	40	45	40	50	44	29	39	18	38	39	32	50	52	21	15	16	10	23	40	50	41	43		16	34
41. 1st Digit Canc(S3)	17	00	25	08	15	25	17	17	00	03	15	03	17	26	16	13	10	07	13	15	14	15	11	08	12	10	11	10	22	17	20	05	13	03	17	16	16	05	13	33		30
42. Letter A (S4)	30	31	17	35	09	12	25	30	24	08	29	21	28	11	35	24	19	18	18	18	19	35	22	14	12	21	15	10	19	21	35	27	33	25	27	22	22	37	31	32	44	

APPENDIX D.2

Intercorrelations of 42 variables for 155 boys (Above Diagonal) and for 130 girls (Below Diagonal) in lower class socio-economic areas.
(Decimal points omitted)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
1. Verbal Intell.(R7)		77	53	62	56	61	74	76	66	48	74	67	79	49	77	65	74	66	64	70	73	70	60	66	53	67	58	53	76	63	29	49	38	42	44	43	56	69	64	60	18	41
2. Word Sounds (P1)	63		53	63	55	59	71	70	63	45	69	56	72	44	75	54	65	61	55	62	69	62	56	62	50	60	58	45	66	57	30	38	28	35	34	38	58	65	59	65	16	31
3. Hidden Words(P3)	62	62		55	40	40	48	35	47	39	56	38	54	26	54	36	50	47	50	42	51	43	43	45	38	45	40	26	51	51	36	19	24	23	28	32	51	50	45	50	26	39
4. Find Rhymes(P2)	62	61	60		47	48	62	63	47	30	57	51	60	32	61	43	51	55	52	49	59	53	49	53	40	51	49	37	54	53	20	32	28	25	36	27	56	49	51	55	03	36
5. Word Attack(P4)	36	39	35	43		41	52	51	44	35	47	37	53	30	60	45	57	47	51	46	52	45	35	46	27	42	44	45	55	51	29	28	36	31	28	27	49	46	41	45	16	27
6. Words Uses(G1)	46	49	43	57	25		52	55	42	24	58	47	56	35	59	48	52	48	48	44	58	46	46	49	32	42	45	31	55	48	15	27	21	27	26	26	44	42	38	49	12	26
7. Ling Markers(G2)	66	59	58	60	42	50		71	60	60	77	68	75	42	73	50	71	62	56	67	67	64	61	62	44	61	57	48	65	66	34	36	33	33	34	43	56	63	60	60	16	38
8. Scrambled Sent(G5)	69	69	60	61	42	45	69		66	53	74	69	79	43	77	58	74	69	62	66	68	66	64	72	47	66	64	54	68	67	29	47	36	50	45	37	58	67	66	65	19	36
9. Combining Sent(G6)	51	49	41	45	31	38	51	58		49	61	48	69	33	64	47	62	54	47	62	56	60	60	68	43	56	60	47	60	56	28	39	26	35	36	25	51	60	56	55	15	34
10. Comp.Sen.Struc(G7)	40	41	45	45	29	39	48	41	38		59	44	55	39	50	25	50	45	33	52	41	48	39	46	39	38	48	29	44	46	36	21	17	22	06	26	46	50	51	47	18	30
11. Anaphora(G8)	66	61	56	60	38	46	65	67	55	53		71	79	39	70	54	73	67	59	62	66	63	57	69	47	60	63	49	67	69	28	35	27	30	30	41	66	59	61	70	14	42
12. Embedded Sent.(G9)	58	62	50	50	43	36	67	65	50	43	69		67	30	58	48	63	55	54	56	62	55	47	59	35	46	54	39	61	59	16	38	33	26	28	26	53	51	52	59	05	25
13. Deep Structure(G10)	72	65	61	67	38	52	74	74	61	52	68	66		42	80	61	78	70	65	65	69	73	64	77	45	67	69	57	70	70	31	45	39	44	46	31	60	71	54	70	13	43
14. Ambiguous Sent(G11)	30	21	14	14	13	07	29	26	25	11	27	30	32		48	61	44	40	36	42	35	40	36	31	27	43	38	37	43	41	20	34	16	21	19	23	34	39	42	30	11	29
15. Voc.no con. (L1)	71	73	66	73	43	59	70	70	35	50	64	61	75	27		68	79	70	71	65	71	68	60	70	48	69	64	59	77	72	33	47	41	41	36	24	60	63	61	85	07	31
16. Eng.Pic.Voc.(L2)	60	45	41	45	29	46	46	56	47	27	51	43	54	14	58		58	52	62	52	54	50	39	52	37	49	54	44	63	53	17	46	40	32	35	24	41	48	44	50	08	36
17. Voc. in con.(L3)	70	58	58	53	45	47	68	66	52	56	69	62	69	23	69	59		65	67	68	65	68	58	71	47	67	62	50	68	72	29	43	38	44	32	28	33	61	64	59	06	35
18. Res.Sh.Lit.Rdg(C1)	58	54	46	51	37	45	56	66	60	39	57	61	68	30	67	62	61		59	64	63	64	62	69	38	60	65	57	64	64	24	41	30	35	39	35	56	59	53	60	-04	32
19. Res. Sh.Imp.Rdg(C2)	58	55	44	49	41	38	62	60	49	40	58	62	62	24	66	55	66	69		56	57	58	49	61	39	54	55	48	70	69	17	30	33	25	34	31	54	50	51	52	03	34
20. Mult.Ch.Rdg.(C3)	59	54	55	57	32	47	56	58	51	46	60	55	65	14	62	49	58	63	61		57	68	57	68	47	56	58	47	68	58	23	37	31	33	30	37	51	64	55	56	09	38
21. Cloze Rdg(C4)	64	62	56	53	36	43	50	59	39	46	58	51	60	35	66	56	61	60	50	51		64	60	63	45	59	61	47	65	65	36	39	34	36	33	35	52	59	59	70	10	27
22. Chunked Rdg(C5)	64	54	51	58	26	51	57	62	49	40	56	56	69	18	72	59	57	67	56	63	61		56	68	50	65	64	55	67	63	23	46	31	36	30	29	50	60	60	57	06	30
23. Comp.Ques.(C6)	35	40	34	39	18	15	27	45	38	31	38	38	49	29	41	26	37	37	44	42	44	32		70	39	48	51	46	49	57	23	32	27	32	29	30	48	57	54	53	03	39
24. Comp.Statements(C7)	72	59	51	60	40	44	60	66	55	45	70	60	68	21	65	50	65	64	61	63	64	60	65		41	60	66	51	65	69	22	64	34	37	40	25	56	63	64	62	-01	32
25. Foll.Inst.A(C8)	45	50	57	51	33	47	47	53	33	40	44	38	56	22	54	42	50	47	39	44	54	48	43	43		50	33	36	47	38	26	31	23	30	26	21	38	43	39	40	13	19
26. Foll.Inst.B(C9)	60	58	57	54	34	37	58	58	45	43	62	52	62	24	63	41	62	50	53	49	51	50	36	57	50		52	51	59	65	34	45	31	37	38	24	49	59	60	48	14	35
27. Comp.Expl.Inf.(C10)	53	48	53	46	39	39	61	61	58	33	60	64	61	27	57	57	61	63	63	56	40	52	30	52	46	39		62	64	61	12	31	30	33	38	17	48	57	56	59	05	25
28. Comp.Imp.Inf.(C11)	51	37	31	38	23	34	49	47	46	32	40	42	54	17	45	35	47	49	48	43	34	46	17	45	33	27	54		48	52	16	39	18	23	36	11	40	46	47	50	-01	24
29. Rdg.Note Det(C12)	52	48	46	44	30	33	56	57	45	40	53	55	61	39	60	50	54	60	62	47	49	51	42	61	40	60	49	47		67	29	42	43	37	38	33	56	58	56	57	11	33
30. Rdg. for Inf(C13)	60	56	50	58	33	51	54	63	54	50	65	60	64	36	65	49	63	54	57	61	57	59	40	63	46	48	54	38	48		39	35	29	31	35	31	64	57	59	60	09	37
31. Letter Grp (R1)	43	28	34	27	11	36	40	35	19	34	35	37	43	02	32	22	37	32	21	30	12	37	21	36	38	35	30	20	27	35		19	20	23	22	31	39	27	30	25	40	28
32. Prog.Mat A,B(R2)	43	24	32	30	20	33	33	39	26	27	34	29	35	16	31	30	39	31	34	23	33	27	22	28	32	23	33	24	22	37	29		54	59	38	21	17	46	39	40	-07	11
33. Prog.Mat.C(R3)	39	28	35	38	30	13	47	36	34	15	37	32	39	24	35	31	30	28	22	28	29	31	24	32	33	39	31	03	30	38	17	45		55	42	07	14	40	30	21	03	13
34. Prog.Mat.D(R4)	35	28	35	29	14	11	29	40	22	19	37	29	33	31	40	30	29	30	21	24	35	30	29	35	35	44	34	07	30	34	16	44	53		43	09	15	46	38	24	11	10
35. Prog.Mat.E(R5)	41	35	38	30	10	21	40	40	39	40	48	40	45	19	46	33	48	34	35	31	36	31	39	41	34	40	42	25	34	46	29	34	40	50		29	26	38	37	25	27	38
36. Th.Reasoning(R6)	34	10	14	03	02	15	17	24	02	07	16	12	13	05	17	28	25	22	17	10	16	15	08	20	15	29	11	13	21	15	29	20	00	16	18		33	27	23	33	27	22
37. C-C Spd.Rdg(S2)	58	56	60	53	45	44	56	61	53	48	67	55	61	25	65	52	70	54	60	53	59	54	38	08	50	50	38	41	49	64	20	29	23	30	45	13		51	34	64	18	37
38. Punctuation A(G3)	67	59	59	59	44	46	65	59	36	42	60	53	65	17	70	49	63	54	55	55	51	65	32	51	45	69	45	37	48	67	36	22	33	33	38	17	54		81	59	14	35
39. Punctuation B(G4)	62	58	54	58	39	44	54	54	42	49	60	52	66	19	65	47	61	52	55	55	44	64	34	51	46	63	48	44	56	50	35	22	38	26	40	07	56	77		59	22	41
40. Speeded Cloze(S1)	63	59	56	51	39	43	40	54	52	39	63	62	61	22	59	38	63	48	50	53	56	50	32	57	33	48	47	40	43	62	37	31	22	12	37	14	62	51	45		08	33
41. 1st Digit Canc(S3)	33	21	32	26	27	38	36	38	21	35	34	38	34	18	29	15	27	24	25	31	16	21	18	34	29	34	26	24	30	37	40	33	17	23	22	12	32	38	35	36		33
42. Letter A(S4)	43	39	46	35	18	34	50	67	31	36	45	45	47	26	42	33	46	43	35	42	31	43	27	33	41	53	40	32	42	35	39	33	16	25	40	21	35	47	52	33	47	

APPENDIX E.1

VARIMAX-ROTATED MAXIMUM LIKELIHOOD FACTOR SOLUTION FOR MIDDLE CLASS BOYS

(Decimal points omitted)

Test	FACTORS I	II	III	IV	V	VI
1. R7. Verbal Intell.	380	231	328	321	468	256
2. P1. Word Sounds	205	009	086	057	488	078
3. P3. Hidden Words	251	094	533	-017	238	070
4. P2. Find Rhymes	178	303	189	061	499	238
5. P4. Word Attack	240	205	282	085	340	150
6. G1. Word Uses	148	076	211	014	371	181
7. G2. Ling. Markers	329	200	108	177	633	402
8. G5. Scrambled Sent.	330	152	276	225	504	236
9. G6. Combining Sent	358	099	151	263	348	516
10. G7. Comp. Sent. Struc	316	099	282	053	234	260
11. G8. Anaphora	362	190	166	197	441	239
12. G9. Embedded Sent.	275	227	167	246	559	274
13. G10. Deep Structure	331	175	411	216	400	430
14. G11. Ambiguous Sent	158	120	037	118	142	274
15. L1 Voc. no con.	448	188	344	202	534	190
16. L2. Eng. Pic. Voc.	410	166	273	161	170	168
17. L3. Voc. in context	342	258	325	259	398	323
18. C1. Bas.Sk. Lit. Rdg.	542	026	020	242	467	197
19. C2. Bas.Sk. Imp. Rdg.	568	009	111	233	369	322
20. C3. Mult. Ch. Rdg.	445	216	060	267	299	337
21. C4. Cloze Rdg.	213	132	293	237	299	372
22. C5. Chunked Rdg.	411	209	375	138	309	343
23. C6. Comp. Ques.	239	220	073	053	239	609
24. C7. Comp. Statements	533	153	135	155	204	662
25. C8. Foll. Inst.A	245	006	153	221	332	365
26. C9. Foll.Inst.B	275	071	332	367	177	402
27. C10. Comp.Expl.Inf.	715	101	116	042	221	151
28. C11. Comp.Imp.Inf.	631	054	131	076	157	207
29. C12. Rdg.Note Det	581	197	170	138	403	155
30. C13. Rdg. for Inf	614	090	136	027	287	397
31. R1. Letter Grp	080	012	552	077	127	-020
32. R2. Prog.Mat A,B	071	009	052	495	209	039
33. R3. Prog.Mat.C	027	160	167	491	116	186
34. R4. Prog.Mat.D	022	036	226	569	124	159
35. R5. Prog.Mat.E	180	106	010	618	-099	013
36. R6. Th.Reasoning	267	170	545	139	006	053
37. S2. C-C Spd.Rdg	320	271	441	-175	425	214
38. G3. Punctuation A	051	637	206	165	376	274
39. G4. Punctuation B	258	830	177	248	159	174
40. S1. Speeded Cloze	392	336	366	005	433	125
41. S3. 1st Digit Canc	-023	-026	528	165	005	113
42. S4. Letter A	-011	100	369	076	143	078

APPENDIX E.2

VARIMAX-ROTATED MAXIMUM LIKELIHOOD FACTOR SOLUTION FOR MIDDLE CLASS GIRLS

(Decimal points omitted)

	FACTORS							
Test	I	II	III	IV	V	VI	VII	VIII
1. R7. Verbal Intell.	102	425	521	381	150	069	291	238
2. P1. Word Sounds	175	138	421	330	-017	254	084	-030
3. P3. Hidden Words	024	009	400	185	198	202	156	681
4. P2. Find Rhymes	129	244	374	499	016	138	235	195
5. P4. Word Attack	159	032	382	281	089	059	050	223
6. G1. Word Uses	027	-036	284	045	273	176	195	098
7. G2. Ling. Markers	058	327	523	240	093	292	210	152
8. G5. Scrambled Sent.	075	349	400	378	119	273	340	047
9. G6. Combining Sent.	110	520	469	213	-052	222	-015	035
10. G7. Comp. Sent. Struc	027	046	491	193	049	-026	-140	167
11. G8. Anaphora	166	215	544	345	115	132	325	-002
12. G9. Embedded Sent.	103	297	341	255	-012	250	483	080
13. G10. Deep Structure	204	399	454	402	128	240	282	094
14. G11. Ambiguous Sent	931	201	222	123	122	021	087	029
15. L1. Voc. no con.	105	239	686	232	114	138	194	229
16. L2. Eng. Pic. Voc.	000	321	554	157	055	-021	322	212
17. L3. Voc. in context	091	228	651	255	035	130	165	229
18. C1. Bas. Sk. Lit. Rdg.	144	441	531	164	-032	276	213	047
19. C2. Bas. Sk. Imp. Rdg.	028	199	732	049	092	209	084	-010
20. C3. Mult. Ch. Rdg.	083	318	474	127	086	241	152	056
21. C4. Cloze Rdg.	097	238	486	138	109	090	408	093
22. C5. Chunked Rdg.	134	375	501	148	132	178	264	-003
23. C6. Comp. Ques.	-043	186	342	179	102	640	060	081
24. C7. Comp. Statements	104	265	547	228	016	325	086	-033
25. C8. Foll. Inst. A	044	326	019	137	065	366	147	141
26. C9. Foll. Inst. B	091	437	290	212	047	305	370	172
27. C10. Comp. Exp. Inf.	113	328	655	112	002	210	112	-049
28. C11. Comp. Imp. Inf.	062	314	517	107	011	057	028	076
29. C12. Rdg. Note Det	119	199	534	181	134	267	239	206
30. C13. Rdg. for Inf	022	104	626	157	161	394	116	050
31. R1. Letter Grp	-074	272	130	294	295	-010	-051	212
32. R2. Prog. Mat.A,B	075	537	130	113	058	127	177	028
33. R3. Prog. Mat.C	084	443	104	082	195	-006	075	057
34. R4. Prog. Mat.D	-023	755	266	078	010	059	-060	-070
35. R5. Prog. Mat.E	064	367	175	240	211	225	033	-013
36. R6. Th. Reasoning	-103	204	442	143	198	-203	088	150
37. S2. C-C Spd. Rdg	032	051	619	250	156	-009	221	064
38. G3. Punctuation A	039	213	280	754	026	189	178	076
39. G4. Punctuation B	039	179	276	741	175	110	066	066
40. S1. Speeded Cloze	-024	-035	523	248	337	034	428	074
41. S3. 1st Digit Canc.	166	024	060	-047	710	064	013	111
42. S4. Letter A	-069	274	067	215	589	036	062	-046

APPENDIX E.3

VARIMAX-ROTATED MAXIMUM LIKELIHOOD FACTOR SOLUTION FOR LOWER CLASS BOYS

(Decimal points omitted)

	FACTORS						
Test	I	II	III	IV	V	VI	VII
1. R7. Verbal Intell.	137	596	337	247	069	363	404
2. P1. Word Sounds	135	590	212	235	001	372	346
3. P3. Hidden Words	039	447	082	439	-008	112	251
4. P2. Find Rhymes	107	553	133	212	-059	238	274
5. P4. Word Attack	020	387	218	238	046	071	422
6. G1. Word Uses	005	475	129	136	-090	327	352
7. G2. Ling. Markers	077	651	199	307	244	217	278
8. G5. Scrambled Sent.	124	682	352	266	056	146	264
9. G6. Combining Sent.	078	650	294	200	117	092	130
10. G7. Comp. Sent. Struc	133	525	060	279	537	003	050
11. G8. Anaphora	082	741	101	294	148	173	261
12. G9. Embedded Sent.	104	627	133	117	094	214	261
13. G10. Deep Structure	206	736	314	228	059	095	287
14. G11. Ambiguous Sent	183	258	124	147	133	118	410
15. L1. Voc. no con.	067	641	311	153	103	089	525
16. L2. Eng. Pic. Voc.	050	418	317	063	-076	149	521
17. L3. Voc. in content	115	645	318	162	162	002	422
18. C1. Bas. Sk. Lit. Rdg.	025	715	259	094	-005	080	256
19. C2. Bas. Sk. Imp. Rdg.	048	555	150	150	-105	-053	578
20. C3. Mult. Ch. Rdg.	074	636	264	149	196	125	257
21. C4. Cloze Rdg.	141	642	184	153	-018	274	330
22. C5. Chunked Rdg.	136	657	293	087	145	082	282
23. C6. Comp. Ques.	094	709	224	123	-025	079	047
24. C7. Comp. Statements	122	821	296	080	-054	-056	136
25. C8. Foll. Inst. A	047	370	240	189	166	171	216
26. C9. Foll. Inst. B	160	523	325	224	060	021	350
27. C10. Comp. Expl.Inf.	135	698	147	009	068	004	289
28. C11. Comp. Imp. Inf.	119	537	194	-032	018	-017	310
29. C12. Rdg. Note Det	032	564	294	189	050	131	516
30. C13. Rdg. for Inf	067	676	154	272	-007	-143	403
31 R1. Letter Grp	015	128	177	551	107	-066	119
32. R2. Prog. Mat. A,B	095	274	671	-051	025	127	139
33. R3. Prog. Mat. C	014	125	654	095	004	-039	214
34. R4. Prog. Mat. D	089	169	744	124	063	044	064
35. R5. Prog. Mat. E	044	232	498	354	-353	064	080
36. R6. Th. Reasoning	-075	272	053	419	-002	295	064
37. S2. C-C Spd. Rdg	115	621	-068	359	005	062	259
38. G3. Punctuation A	465	536	373	208	111	122	181
39. G4. Punctuation B	737	533	243	273	058	-011	175
40. S1. Speeded Cloze	164	680	087	162	030	247	224
41. S3. 1st Digit Canc.	100	-093	029	677	025	082	005
42. S4. Letter A	126	295	038	456	-026	003	134

APPENDIX E.4

VARIMAX-ROTATED MAXIMUM LIKELIHOOD FACTOR SOLUTION FOR LOWER CLASS GIRLS

(Decimal points omitted)

	FACTORS					
Test	I	II	III	IV	V	VI
1. R7. Verbal Intell.	358	255	303	593	142	168
2. P1. Word Sounds	296	186	198	667	157	024
3. P3. Hidden Words	189	280	309	589	157	036
4. P2. Find Rhymes	243	241	184	724	065	-175
5. P4. Word Attack	241	069	198	374	129	-015
6. G1. Word Uses	271	012	182	550	082	-022
7. G2. Ling. Markers	448	237	456	477	107	-043
8. G5. Scrambled Sent.	492	333	221	516	133	085
9. G6. Combining Sent.	590	222	128	315	177	-092
10. G7. Comp. Sent. Struc	180	111	314	423	220	134
11. G8. Anaphora	397	292	356	482	278	102
12. G9. Embedded Sent.	525	226	328	378	234	031
13. G10. Deep Structure	497	254	334	583	090	004
14. G11. Ambiguous Sent	251	244	099	069	077	053
15. L1. Voc. no con.	396	254	220	720	043	077
16. L2. Eng. Pic. Voc.	493	214	037	430	-034	273
17. L3. Voc. in context	440	185	378	483	248	268
18. C1. Bas.Sk. Lit. Rdg.	678	188	093	440	-032	217
19. C2. Bas.Sk. Imp. Rdg.	617	090	226	411	071	193
20. C3. Mult. Ch. Rdg.	480	126	223	514	067	054
21. C4. Cloze Rdg.	253	248	-063	686	222	332
22. C5. Chunked Rdg.	458	157	170	614	-110	134
23. C6. Comp. Ques.	227	295	091	324	129	106
24. C7. Comp. Statements	451	254	142	531	229	172
25. C8. Foll. Inst. A	229	315	156	484	032	113
26. C9. Foll. Inst. B	175	309	447	517	-018	246
27. C10. Comp. Exp. Inf.	686	283	237	241	108	002
28. C11. Comp. Imp. Inf.	578	-046	230	226	070	097
29. C12. Rdg. Note Det	481	176	255	370	010	260
30. C13. Rdg. for Inf	391	273	209	474	358	088
31. R1. Letter Grp	176	133	467	156	085	053
32. R2. Prog. Mat. A,B	165	497	139	123	195	095
33. R3. Prog. Mat. C	101	652	165	223	-072	-151
34. R4. Prog. Mat. D	050	798	081	160	-072	191
35. R5. Prog. Mat. E	195	495	294	173	168	174
36. R6. Th. Reasoning	091	092	152	024	030	449
37. S2. C-C Spd. Rdg	384	191	238	501	312	170
38. G3. Punctuation A	204	144	517	635	-153	161
39. G4. Punctuation B	290	135	531	568	-166	054
40. S1. Speeded Cloze	317	062	317	495	487	041
41. S3. 1st Digit Canc.	095	159	532	109	159	083
42. S4. Letter A	255	17[illegible]	498	239	-038	174

APPENDIX F

STANDARD DEVIATIONS OF SCORES OF EACH SEX AND SOCIO-ECONOMIC GROUPING ON EACH TEST

	Middle Class Boys (N=166)	Middle Class Girls (N=173)	Lower Class Boys (N=155)	Lower Class Girls (N=130)
Age	4.61	5.58	4.37	5.16
P1. Word Sounds	2.05	1.91	4.26	3.71
P2. Finding Rhymes	6.63	5.27	9.53	8.94
P3. Hidden Words	5.20	5.13	5.75	6.16
P4. Word Attack	2.70	2.66	3.21	3.00
G1. Word Uses	2.36	1.74	2.52	2.70
G2. Linguistic Markers	4.36	3.53	5.31	4.31
G3. Punctuation A	4.57	4.42	5.68	4.94
G4. Punctuation B	6.79	6.49	7.29	6.67
G5. Scrambled Sentences	3.97	3.60	4.88	4.60
G6. Combining Sentences	3.57	3.28	3.94	3.93
G7. Compreh. Sent. Struct.	7.82	5.46	11.24	7.85
G8. Anaphora	6.75	5.12	10.03	7.50
G9. Embedded Sentences	3.98	3.53	5.05	4.51
G10. Deep Structure	5.59	4.77	7.26	6.68
G11. Ambiguous Sent.	3.44	3.27	3.22	3.02
L1. Vocab, no context	5.29	4.54	6.99	6.71
L2. Eng. Pict. Vocab.	4.16	4.59	4.95	5.33
L3. Vocab. in context	4.11	4.15	4.96	4.81
C1. Basic Sk. Lit. Mng.	2.66	2.41	3.22	2.88
C2. Basic Sk. Imp. Mng.	2.58	2.71	2.82	2.89
C3. Mult. Choice Rdg.	3.30	2.79	4.33	3.63
C4. Cloze Rdg. Compreh.	3.66	3.53	4.92	4.40
C5. Chunked Rdg. Comp.	3.30	3.40	4.03	3.94
C6. Compreh. Questions	2.69	1.69	4.22	2.72
C7. Compreh. Statements	3.27	2.58	4.36	3.41
C8. Following Inst. A	1.23	0.85	1.65	1.32
C9. Following Inst. B	2.18	1.95	2.27	2.15
C10. Explicit Inf. Rdg.	3.09	2.56	3.07	3.06
C11. Implicit Inf. Rdg.	1.51	1.43	1.42	1.41
C12. Rdg. Note Details	2.52	2.68	2.77	2.51
C13. Rdg. for Inference	2.62	2.44	2.97	2.80
R1. Letter Grouping	3.85	4.41	4.14	4.08
R2. Prog. Matrices A+B	2.90	2.25	3.42	3.24
R3. Prog. Matrices C	2.09	1.72	2.41	2.28
R4. Prog. Matrices D	2.20	1.89	2.77	2.54
R5. Prog. Matrices E	2.10	2.04	[illegible].06	2.28
R6. Thurstone Reasoning	5.24	4.66	4.[illegible]	4.34
R7. Verbal Intell. Raw Sc.	13.09	13.10	14.79	12.81
- Prog. Mat. Tot. Raw Sc.	6.99	5.83	8.79	8.28
- Verbal I.Q.	12.00	11.76	14.00	12.15
- Prog. Mat. I.Q.	12.41	11.12	15.45	14.83
S1. Speeded Cloze Rdg.	4.35	3.88	4.42	3.95
S2. Chapman Cook Spd. Rdg.	3.68	3.84	5.05	4.54
S3. 1st Digit Cancellation	11.63	11.60	12.19	13.71
S4. Letter A	4.41	5.63	6.27	5.99

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